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SEARCHING AFTER THE UNATTAINABLE.

EVERY now and then we come across old and impossible schemes which for a few years are allowed to remain buried in obscurity and are then suddenly and periodically awakened into new life and brought forward as revolutionary ideas. In our issue of the 11th inst., when commenting upon the prize offered by a recently launched contemporary for a new design for an electro-motor we said:—"But there exists, also, that large class of would-be-inventors who are an absolute nuisance to their employers through wasting time and materials on worthless schemes, and it is on account of these half-educated, and often obstinate, men, that some firms suppress, by direct orders, all effort in this direction."

A favourite notion with this class of individual is that of contriving, by ingenious but futile reasoning, to make copper conductors with a surface area as large as possible, ignoring altogether the fact that conductivity depends upon the sectional area or the weight of copper in the conductor.

A second absurdity, not quite so well known as the foregoing, is the belief which still exists in the minds of some men, that the electrical energy consumed in one electric lamp may be made, by suitable devices, to actuate any number of others.

A Mr. John Palmer sends to an engineering contemporary a device, and, to quote his own words, "if this would answer it would practically revolutionise electric lighting." Precisely, but unfortunately for Mr. John Palmer his idea, a well-worn one by the way, is utterly fallacious.

The apparatus he proposes to construct is the following:—

"A disc consisting of hard wood, or vulcanised fibre, around the edge of which are fixed a number of brass contact pieces, with binding screws, for connecting wires from incandescent lamps. In the centre of the disc there revolves a metallic arm, carrying at the end of it a brass brush to make contact with the contact pieces fixed on the disc. The revolving arm is to make about 2,000 revolutions a minute, so that the current is switched on and off each lamp 2,000 times every minute. Under these circumstances the whole of the lamps would appear to be continuously incandescent, owing to the persistency of retention of the retina of the eye; and the current necessary to keep all the sixteen lamps alight would only be what is ordinarily required for one, say a current of 5 ampères and 100 volts. As the whole of this current would certainly pass through each lamp 2,000 times a minute—each time the revolving brush made contact with the contact piece in connection with that particular lamp—it would appear as if it was a continuous current going through the filament."

A pretty idea certainly, and wonderfully economical.

Some six or eight years ago a Mr. Harrison advocated a precisely similar system. In his case, the actual working apparatus consisted of a small Gramme machine and one or two of Harrison's arc lamps, but the commutator with the revolving arm formed part of the scheme, although we do not know that the apparatus was ever constructed. At all events visitors were assured that 100 lamps similar to those in operation would be actuated by the small dynamo, and with only the same expenditure of power as would be required for the illumination of one lamp. If we are not mistaken the same idea may be found in a patent granted to a gentleman some years ago who was then, and is still, a shining light in the electrical world.

Doubtless Mr. Palmer did not take into consideration such little mishaps as the burning up of his commutator and dynamo; but he might have asked himself, can it be possible to work 20 lamps with no greater consumption of electrical energy than when only one lamp is burning? Had he done so he would probably have consigned his communication to the flames or the waste paper basket. But perhaps this remark is premature. Mr. Palmer, if we mistake not, is the same gentleman who has sent us a design for eliminating the counter-electromotive force of electro-motors; thus trying to do away with the very element which determines their efficiency.

Here, however, is a sad instance of a mind, ingenious enough in a way, entirely misdirected, apparently through the want of a thorough elementary instruction in electrical science. Mr. Palmer, however, does not stand alone; there are still many minds constantly engaged in searching after the unattainable.

THE ELECTRIC LIGHT AND NAVAL WARFARE.

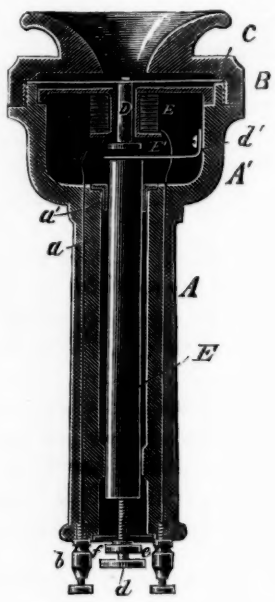
THE manœuvres carried out during last week at Milford Haven afforded to the authorities an excellent opportunity of testing the value of electricity, and particularly electric lighting, in naval warfare. The main object of these imitation battles was to ascertain the best means of protecting mines against a sustained attempt to force them by a squadron, the value of torpedo boats to the defence, the best modes of manœuvring them, and the most suitable organisation for the whole of the defensive operations. Electricity in one or other of the forms mentioned came into play very early, and throughout the operations exercised a most potent influence on the engagement. The electric light is peculiarly the enemy of the torpedo boat, and in this direction it rendered most valuable service again and again, but it has to be admitted that, partly perhaps through defective apparatus and partly because of a misunderstanding as to instructions, the light acted very erratically occasionally, and even played into the enemy's hands, on one side or the other. The course laid out for the attacking squadron was thickly laid with submarine mines, to be exploded either by contact or by electricity from the land. There was also a heavy boom barring the way, and besides these a defending flotilla of gun boats, torpedo boats, and guard boats. Their duty was to be on the *qui vive* to prevent the enemy approaching, and to guard against an advance in the darkness of night; powerful beams of electric light were provided at South Hook and Stack Forts, elevated points commanding the scene

of the fight. The torpedo boats also carried electric lights. Thus there appeared to be small chance indeed of an antagonist getting close in; but the attacking ironclads also had electric lights to protect themselves against a covert attack, and the brilliant illumination at times is described as having been so general that neither side could hope for concealment. Both sides therefore would seem to have been on an equality in this respect, but it was discovered during the battle that opposing forces may add the light to their guns and other weapons. Electric beams may be met with beams, and the strongest beam will overcome and practically put out the weaker, just as one gun may silence another. This is a factor that will probably largely prevail in hostile encounters both on sea and on land. But the leading purpose of the light was of course to enable each side to detect the movements of the other; and a curious condition laid down for these operations was that neither guns "nor electric lights" were to be put out of action—a condition which certainly would not prevail in actual warfare.

Before the engagement began, and while defenders and opponents were vigilantly waiting upon each other, a curious instance of a disadvantage of the electric light occurred. Between one and two o'clock in the morning some objects that had been seen to move swiftly across the belt of light, were at once clearly shown up by the powerful Brush lamp on South Hook Fort, and it was only after the enemy had been enabled by this means to see distinctly what was going on, that the defenders found they had been illuminating their own boats. Meanwhile, the electric beams of the enemy, emulating those on shore, continually swept the water, so that no small craft, however swift, could elude detection, and no torpedo boat could get within striking distance of an ironclad. The first encounter having taken place, Sir William Hewitt, commanding the attacking squadron, chose the hour immediately following twilight on the Tuesday to renew his assault, and the defenders selected the same time for an attack on their part. In view of this counter attack, Sir William Hewitt turned on in their full strength the electric lights of his ironclads, and these spreading a bright searching light all round, quickly disclosed the defending boats and enabled the enemy to frustrate the counter movement. Then a pretty brisk engagement took place, favourable at first to the assailants, but in the end a flood of light skilfully worked from the shore, led to their discomfiture. Shortly after this, one of the enemy's boats, making for the mines, was brought into prominence by the light from Hook Fort and quickly driven back. On the manœuvres being again resumed in the dark, three of the attacking ironclads were put into a position from which their electric lights could play directly upon South Hook Fort, and they managed to throw such blinding flashes into the eyes of the men working the guns in the Fort, that the latter had no chance of firing with any success. On the other hand, the same light in one instance failed to follow the enemy's boats, and Sir William Hewitt's movements became dangerous to the defenders, and in another instance the only result of the South Hook light being turned upon a solitary gun-boat detected was to concentrate an attack upon her while the enemy were working out a more serious manœuvre. Similar tactics were pursued later on by the enemy, who repeated the operation of flashing the lights in the eyes of the men in the batteries, and suddenly shutting off the light to conceal their own whereabouts, while they executed some wily design under cover of the dark, or of the smoke from the guns of their smaller craft. So the opposing forces seemed to gain alternate advantage from the use of this new aid to warfare, but on the whole, the balance of gain in this respect rested with the enemy, although in the end they failed to win a victory over the gallant defenders. In one case the light at South Hook Fort went out suddenly, and thereby the enemy were enabled to play havoc with the boom and some of the mines; while apparently not to be inferior, the Stack Fort light on another occasion refused to act for some hours. Perfect working was not, however, to be quite expected, and the whole experience cannot fail to be of value as a lesson in modern methods of fighting. In the firing of submarine mines, the electric wires seem to have acted admirably from the shore, when they had not already been broken by the enemy's boats.

THE PHELPS TELEPHONE.

As among the latest designs in telephone construction the *Electrical World* describes the instrument shown in the accompanying engraving, which is said to make a very sensitive receiver. As will be seen, it consists of a hand-receiving case, A, containing a diaphragm, C, of any vibratory material (it is not necessarily capable of induction). This is held by its edge being clamped between the rim of the cup-shaped end, A′, and an inner bearing of cap, B. To the centre of the diaphragm is attached a small bar or core, D, made of steel or soft iron, the latter being found preferable on account of its great sensibility when placed near a permanent magnet, and the rapidity with which its magnetism is varied by varying the distance between the iron and magnet. This bar or core is arranged to vibrate freely within an opening formed in the centre of a helix, E.



One end of the bar is provided with a small flange, which end abuts closely to one end of a permanent bar magnet, F. The object of the flanged end is to provide a larger magnetising surface for the bar. A dividing or "anti-sticking" sheet, *d*, is secured within the cup-shaped end, A′, and projects between the ends of bar, D, and magnet, F. This sheet is made of a metal or material upon which the permanent magnet has no effect, such as thin brass or copper. The object of sheet, *d*, is to prevent sticking of the ends of magnet, F, and core, D, should they come together from any cause. The magnet, F, extends lengthwise through the handle of the case and is tightly fitted at the opposite end with an adjustment screw, *d′*.

Between the thumb piece of screw, *d′*, and plate, *f*, a check-nut, *e*, is loosely secured, by which the screw, *d′*, is held at any desired point. A washer, *a′*, *a′*, formed of rubber, is placed around magnet, F, below the bottom of cup, A′, to make the magnet easily adjusted.

In this instrument, which was designed and has been recently patented by Mr. A. M. Phelps, of Seabrook, Md., it will be seen that the current influences primarily a

soft iron core, which then receives motion by its proximity to a permanent magnet.

Mr. Phelps has also employed the instrument as a transmitter. In this case the magnet, F, is placed perpendicular, and the diaphragm, spool and core, D, are made to work transversely.

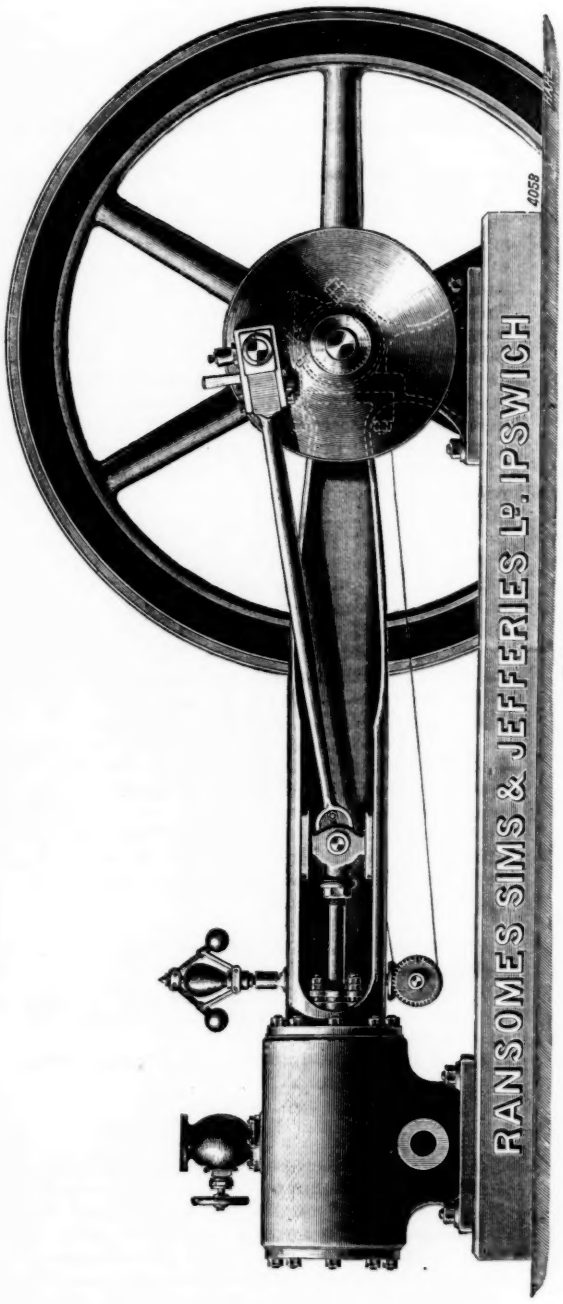


FIG. 1.

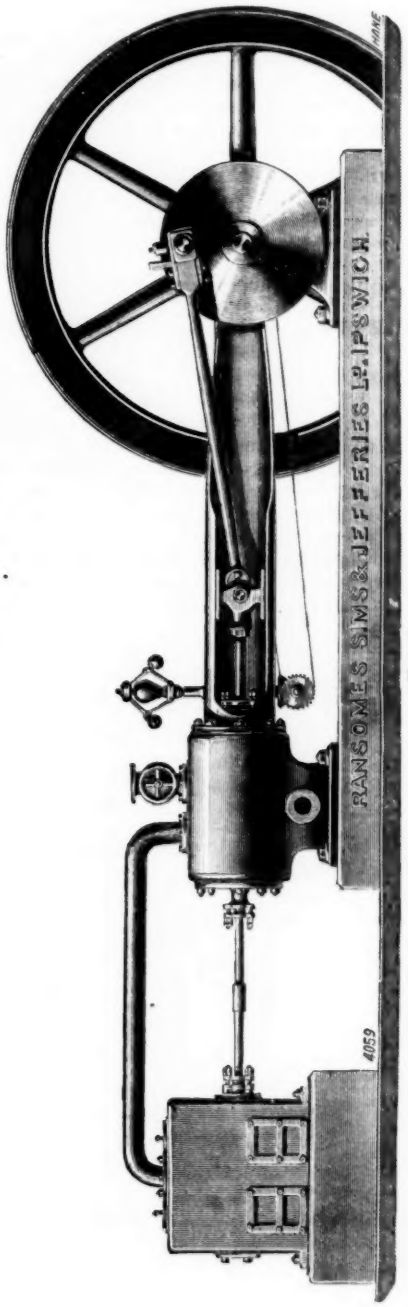


FIG. 2.

NEW LONG-STROKE EXPANSION STATIONARY STEAM ENGINE.

THE engraving (fig. 1) represents a new long-stroke expansion stationary steam engine, designed and manufactured by Ransomes, Sims and Jefferies, Limited, of the Orwell Works, Ipswich, which will be found to present many special advantages.

The engine may be supported upon pillars under the cylinder and crankshaft bearings, or a continuous bed may be provided, if preferred, as shown in the engraving.

The cylinder, which is of large diameter, with a long proportioned stroke, is steam jacketted, and also lagged and cased on the outside. The long stroke that has been adopted admits of a high piston speed and has been found of great advantage for using the steam expansively.

The main framing, as will be seen by the drawing, is in one casting of the hollow type which, while lighter than the ordinary cast iron foundation plate, is considerably stronger, being in a direct line with the throw or thrust of the engine.

The guide bars are formed by the main frame casting which is bored out true, the guide block being circular and so arranged that the wear may be easily taken up at either top or bottom as required.

The main plummer block for supporting the crankshaft and all other parts of the engine are arranged to be interchangeable for either hand, so that the same engine may be used right or left hand without any alteration whatever to the parts.

The governors are of the quick speed type, acting upon an equilibrium piston throttle valve, are very sensitive, and control the movement of the engine with great accuracy.

The engine is fitted with an expansion valve, and can also be supplied with Messrs. Ransomes' patent automatic governor expansion gear, controlled by the governor, an arrangement which admits the exact amount of steam into the cylinder in proportion to the load on the engine, thus effecting a further economy in fuel and ensuring great regularity in speed.

For districts where a supply of water is readily obtainable, it is recommended to fit these engines with an improved condenser, which will add considerably to the economy in fuel. The condenser, which is of efficient design, is placed behind the cylinder (fig. 2), the air pump being worked by an extension of the piston rod through the cylinder cover. The valves and other parts are well arranged and very accessible.

A NEW PROOF OF THE WHEATSTONE BRIDGE.

By SIR DAVID SALOMONS.

THE present proofs are somewhat complex, but the following is extremely simple and clear, and was devised for expressing diagramatically the various uses to which the bridge may be put for daily work.

It may be assumed that the reader understands the use of the bridge in practice, and therefore it will be unnecessary to go into details, so that a general description will suffice. The bridge is generally drawn thus :—

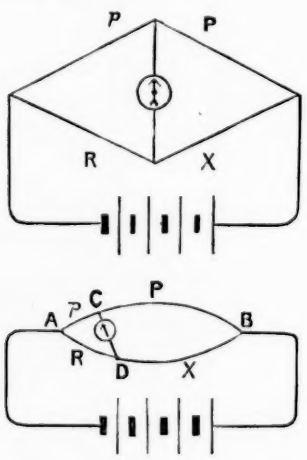
Where

P and ρ = proportionals
R = variable known resistance
X = unknown resistance

then

$$\frac{P}{\rho} = \frac{X}{R} \text{ or } X = R\,\frac{P}{\rho}.$$

Now let us look at the bridge as nothing more than a *shunt*, and draw it thus :—



Here the current divides at A, and goes along two courses, each having any resistance equal or unequal to one another. Clearly the fall of potential between A and B on the upper or lower conductor must be the same, for two differences of potential between A and B cannot exist. Further, the fall along each of the conductors will be regular; hence a point can be found on each conductor which shall have the same difference of potential between each point and A. Call these points C and D, and join them with a galvanometer in the course. Call C A, ρ ; and C B, P ; D A, R ; and D B, X ; and let ρ, P, R and X have the same meanings as in the first figure. Here, however, C and D are movable points. Now move C and D along their own conductors until the galvanometer shows no deflection. At these points the potential must have fallen between A and C, and A and D to an equal extent, and between C and D there is equilibrium, and no current will flow through the galvanometer. When this is the case it is evident that $\frac{P}{\rho} = \frac{X}{R}$ or $X = R\,\frac{P}{\rho}$.

THE ELECTRIC LIGHT IN PARLIAMENT.

IN illustration of the evidence he gave before the House of Lords Committee on the Electric Lighting Bills, Major Armstrong handed in a number of tabular statements dealing with the economical practicability of electric lighting in a detailed manner. He mentioned that the cost of the plant for the installation in the House of Commons had been about £3,300, for, roughly, about 500 glow lamps; and by a separate memorandum he added these particulars :—Description of plant :—No 1. One high-pressure non-condensing engine capable of running 250 16-candle-power incandescent lamps, driving two "K" 250 light each Edison dynamos; each machine working to only one-half of its output. These machines light the three dining rooms, one smoking room, and five libraries; No. of lamps, 250. No. 2. One high-pressure engine similar to the above, driving two "L" 150-light each Edison dynamos. These machines light the pillar lanterns beneath the galleries of the House of Commons chamber, the reporters' "writing off" and telephone rooms, the reading room, tea room, kitchen larder, test lights, &c. ; number of lamps, 245. Total number of lights, 495 ; of this number of lamps, all of which are of the incandescent type, 393 are Edison 16 C.P., 20 Edison 10 C.P., 58 Swan 8 C.P., and 24 Victoria (Anglo-American Company) 20 C.P. One steam boiler, 7 feet in diameter and 28 feet in length, Lancashire type, working at a pressure of 70 lbs. on the square inch. Maintenance :—The cost of maintaining the above number of lights during the last two sessions of Parliament, viz., 1884 and 1885 (56 weeks, including autumn session in 1884), was £824, made up as follows :—

	£
Consumption of coal, 362 tons at 18s. 9d. ...	337
Wages of attendants for two years	374
(*Note.*—During the Parliamentary recess the attendants are employed in effecting alterations and repairs as well as cleaning.)	
General repairs and renewal of lamps (240), oil, waste, &c.	113
Total	£824

The total number of hours during which the machines were at work amount to 2,581. As, however, a portion of the lamps are on the day-light circuit, and their whole number do not come into use until dusk, the total number of lamp hours is ascertained to be 664,646 ; therefore the cost of running that number of lamps for one hour, or one lamp for 664,646 hours, involved an expenditure of £824, which amounts to ·297 of a penny per lamp per hour. The consumption of coal equals nearly 1,850 lamp hours per ton. This consumption is high ; but the plant being only a temporary one, the engines are not of the most economical construction. Thus in working the engines, owing to there being no automatic "cut of" to the steam valves in order to work expansively, a cylinder full of steam is expended 480 times a minute when utilised for a day-light circuit of only 20 lamps, while for the full number of lamps, the speed of the engine is only increased by 40 revolutions. In the one case, however, the steam pressure is somewhat reduced by "wire drawing," while in the other the full pressure of the steam is utilised.

The memorandum next explained that the quantity of 20 candle-power cannel gas burnt in those places now lighted by electricity averaged throughout the Parliamentary session about 50,000 cubic feet per week, which multiplied by 56 weeks, amounted to 2,800,000 at 3s. 9d. This would cost £525, and with other items the total cost for gas would have been for two sessions £740, as against £824 for electric lighting. In this calculation no account was taken either with regard to interest or capital sunk or depreciation. These figures although accurate as to this particular case, required analysis before inferences regarding the general question could be drawn from them. For instance as to gas lighting the wages for attendance would disappear altogether, or be reduced to a comparatively insignificant sum—say £20 a year; on the other hand, as regarded electric lighting, the wages:—(*a*) Should only be for the 56 weeks during which the light was used, instead of being for two years; (*b*) the cost of coal used in economical engines should be taken; (*c*) the price of the lamps in the near future can hardly be maintained at 5s. or 4s. each, the cost of manufacture being only about 1s. 2d.; (*d*) interest on first outlay and depreciation should be taken into account in cases in which electricity would be used to replace existing gas arrangements. Applying these corrections in each case we have the comparative annual costs.

For gas:	£
Value of gas burned	525
Repairs, &c.	12
Wages	20
Total	£557
For electricity:	£
Cost of coal	112
Cost of lamps	60
Wages (very high)	187
Total	£359

To this something must be added for interest on difference of first cost between electrical and gas installations and for the greater depreciation of the former in cases where there are no existing gas arrangements. In cases in which existing gas is replaced by electricity, we should add to the cost of the latter interest on total first cost and depreciation, repairs, &c. The chief point worthy of note in these figures is that the expensive item in the gas installation is the cost of material consumed, viz., £537, which would increase proportionally with a larger consumption. In the electric installation, on the other hand, the value of the material consumed is only about £172, *i.e.*, one-third of the previous amount. The heavy expenses are for wages, interest on first outlay, and repairs and depreciation, and do not increase proportionately with increased consumption!

Major Armstrong's attention being also drawn to the electric light installation at South Kensington Museum he said the cost of lighting in that case had been reduced from £2,500 for gas to £1,100 for electricity—or if the interest on first capital was allowed for, to £1,400, so that there had been an enormous saving by the use of electricity. "But," he added, "they use arc lights to a considerable extent, and the officers who conducted the experiment have assessed the relative cost of lighting by electricity and by gas as two to three when you use the incandescent system, and two to five when you use the arc system." That was in favour of electricity in both cases. In this case, however, there was no question of making large mains for carrying the light from the central station; if that were attempted, under existing conditions, so far as he could see the cost of electricity would be far greater than that of gas. In his memorandum on this instance Major Armstrong further said: "It is six years ago since the first establishment of the electric light in a part of the South Kensington Museum, when 16 lamps and a dynamo on the Brush system were obtained to light the central courts. The results having been satisfactory, the electric lighting has been gradually extended to other parts of the building, and at the present rather more than half of the Museum has the electric light, the remainder being still lighted by gas. No serious inconvenience has ever been caused by failure of the apparatus, nor has any occurrence taken place pointing to any risk of fire, when, as is the case here, the wires, &c., have been carefully laid under proper supervision. At present there are 75 arc lights and 790 glow lamps. The working expenses, including wages, fuel and carbons, repair of machines and lamps, and renewals of glow lamps, amounted during the year to £1,112. The cost of gas for lighting the same portion of the Museum would have been over £2,500; the working expenses of the electric light thus showing a saving of about £1,400; the capital expenditure on boilers, engines, and all electrical plant having been £10,076. Separating, as far as possible, the cost of working the arc lamps from that of the glow lamps, it is found that the former is about two-fifths, and the latter two-thirds that of gas."

Finally, Major Armstrong put in a further statement to this effect:—"Bethnal Green Museum has been lighted by electricity for two years; an agreement was made with the 'Pilsen,' 'Joel,' and General Electric Light Company that they were to make the whole of the installation at their expense, including the erection of a shed for the engine and machinery, to put in 30 arc and 300 glow lamps, and to work the lights for three years, at the end of which time they are to remove all their plant, unless the Department should wish to purchase it. They receive £1,050 a year (the gas having cost about £750). In case of any failure of the apparatus, or any part of it, they have to pay for the gas used. Under this head they have had to pay 14s. 2d. The lighting has been very satisfactorily done, and the reduction of the temperature in the upper galleries, as compared with that when gas was in use, is very marked. The recent arrangement in this museum of the National Portrait Gallery rendered it advisable to have six additional arc lamps, for which £25 a year each is paid. The lighting now is on an average fully 20 per cent. better than by gas, as determined by Mr. Preece's photometer. The South Kensington and Bethnal Green Museums are open on Saturdays, Mondays, and Tuesday evenings until 10 p.m., requiring about 625 hours artificial lighting in a year. The Museum of Practical Geology, in Jermyn Street, has been lighted by electricity for more than five years with satisfactory results. Thirteen 'Brush' arc lamps are used, the motive power being a 12 horse-power 'Otto' gas engine. The cost of working is about £80 a year (400 hours lighting). Two of the lamps are in rooms which used not to be open when the museum was lighted by gas. The consumption of gas used to be 2,100 feet an hour, which, at present price, would cost £157 a year."

THE PROPOSED ELECTRIC LIGHTING AT HOVE.

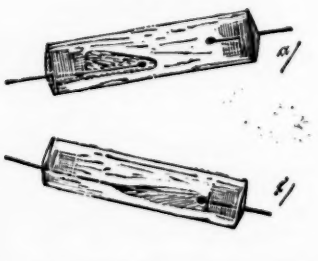
THE question of the desirability of making use of electricity for the purpose of illuminating the sea front of Hove (Sussex) came before the local commissioners on Thursday last week, with the result that it was decided to take no action in the matter. The Brighton Electric Light Company wrote detailing the terms on which they were prepared to carry out the work. They proposed to place arc lamps on posts 24 feet high, of the same candle-power as those in use at the Brighton Railway Station, at a charge of £31 for each lamp per annum, light to be afforded between dusk and eleven p.m.; while if it were desired to make the lighting independent of gas throughout the night, they could place incandescent lamps half way up the posts, which would remain alight the rest of the night at an extra annual charge of £2 per lamp. They did not estimate that the cost would be more than if the "Sugg" lamps

were used. The company would supply the lamps and the necessary cable, the cost of laying the latter and of providing lamp standards being borne by the town. The cable they proposed to lay underground along the sea front, and the cost of carrying out this work would probably be £150 per mile. Of course they could supply lamps of the so-called 2,000 candle-power at a considerably lower charge; but they did not recommend them on account of their unsteadiness and inferiority as compared with those proposed. The Sussex Electric Light Company also mentioned their terms, which were that they would supply, free of cost, all leads, mains, lamps, and everything else necessary for the light, excepting the iron standards, which they required the commissioners to provide, the same remaining their property. They were willing to provide arc lamps of an improved type, attendance, carbons, and electricity from dusk until 11.30 p.m. at a fixed price of 30 guineas per annum for each lamp. In the above charge they were willing to undertake the lighting of such gas lamps as the commissioners might require, or which might be necessary for the public safety. In submitting these letters to the commissioners the surveyor presented a report with the view of showing that electricity would be more expensive than the present system of lighting. Taking as an instance Shoreham Road westward to St. Aubyns, he gave the following comparative statement:—Gas, existing system: 80 lamps at an average cost of £3 10s. per annum, £280. Electricity as proposed, 21 arc lights, each 80 yards apart, at £31 per annum each, £651; gas lighting after 11.30 p.m. when the arc lights are to be extinguished, £156; total, £807. If it were assumed, the surveyor added, that the arc lights should be placed 100 yards apart, the cost would be as follows:—Gas, as above, £280; electricity, 17 arc lights, £527; gas lighting after 11.30 p.m., £156; total, £683. He was of opinion that an additional outlay of £100 upon gas was all that was required, even if that were necessary under existing circumstances. Without discussion it was decided to drop the electric lighting proposals on account of the expense.

A SIMPLE MAKE AND BREAK.

THIS little instrument, recently patented, we believe, by Mr. Raymond Snyers, engineer, of Brussels, is at once simple and practical. The basis of the system consists, as we show in the sketches below (nat. size), of a tube of non-conducting material, hermetically closed at the two extremities by corks, into which are inserted conductors either of iron or of platinum. These con-

Fig.1



ductors have between them some mercury forming electrical contact when one makes the apparatus turn on its axis as in fig. 3.

We see, also, that the conducting wires can be arranged at each extremity of the tube (1) or at the same extremity (2); they can also be placed as in (4) and (3).

This combination is very simple and good. The method of contact, also, is unchangeable, because the parts are absolutely protected. Mr. Snyers applies his system for electrical purposes generally which comprise the transmission of currents, more especially to the electric light and to the "jack knife" of telephones.

It will perhaps be remembered that a precisely

Fig.2

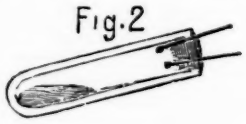


Fig.3

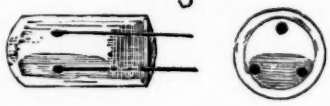
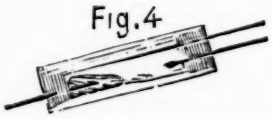


Fig.4



similar arrangement of contact was adopted by Messrs. Walter Emmott and William Ackroyd in their incandescent lamp for the protection of miners published in our issue of June 25th last. The same thing has been effected by Leclanché, as may be seen by referring to specification 3238, p. 223, in the REVIEW for March 25th, 1882.

ON A NEW MEANS OF CONVERTING HEAT ENERGY INTO ELECTRICAL ENERGY.*

By WILLIARD E. CASE, of Auburn, New York, U.S.A.
(Communicated by W. H. PREECE, F.R.S. Received April 14th.)

IT was shown by M. Henri Loewel (see *The Chemist*, Part VIII., p. 476) that the addition of a solution of chromous chloride to stannous chloride caused a precipitate of metallic tin, the reaction forming chromic chloride.

On heating the solution to the boiling point, 212° F., it was found that the precipitated metal was in a great measure re-dissolved, forming the original solution, chromous chloride and stannous chloride, without the liberation of hydrogen.

On cooling this solution the tin was again precipitated, the action continuing as often as the solution was heated and cooled.

As chromous chloride has a great affinity for oxygen, it is necessary that the air should be excluded from the solution, otherwise the chromous chloride would be reduced to oxychloride of chrome, as Loewel states, and the reactions would cease to take place after a time, the stannous chloride formed during each heating remaining in solution.

I constructed, in the form of a simple galvanic cell, a small element with this solution, chromic chloride,† as the electrolyte, using tin as the positive, and platinum as the negative metal.

At 60° F. this element gives no electromotive force, although in this case, when the cell was first set up, it gave 0·0048 volt, owing probably to the presence of some foreign substance.

On the elevation of its temperature by the application of heat, the electromotive force rose and fell.

At the termination of the experiment, when the cell had cooled down to 60° F., no electromotive force was observed.

* From the Proceedings of the Royal Society, No. 244, 1886.

† The solution used was made by combining chromium trioxide with hydrochloric acid, and heating.

The highest electromotive force was 0·2607 volt at 197° F., the highest degree to which the temperature was raised.

If the platinum be replaced by a negative electrode of carbon, the electromotive force will be higher. It may be of interest to mention that the action of this element during heating is entirely different from that of the galvanic battery during a similar elevation of its temperature.

W. H. Preece, F.R.S. (see "The Effects of Temperature on the Electromotive Force and Resistance of Batteries," "Proc. Roy. Soc.," vol. 36, p. 48), states "that changes of temperature do not practically affect electromotive forces, but that they materially affect the internal resistance of cells."

When the temperature of this element was lowered to about 145° F., the reactions before-mentioned took place.

The tin taken up by the solution during heating commenced to precipitate, increasing as the temperature lowered, and the metal fell to the bottom of the cell in a form to be again utilised in the generation of the current.

The amount of local action or chemical corrosion which took place above 150° F. was excessive, but the metal taken up by the solution was very much less when the temperature of the electrolyte was not raised above the point of precipitation, 140° F.

The metal taken up below this point appears to be precipitated under the same conditions as that taken up at higher temperature, and seems to be precipitated whether the circuit be open or closed.

With falling temperature the electromotive force increased between 150° F. and 140° F.; this might have been due to the reactions which took place during the precipitation of the metal.

Further investigations to determine the efficiency of this element would be of interest.

REVIEW.

Arc and Glow Lamps. By JULIUS MAIER, Ph. D., London: Whittaker and Bell and Sons.

This is one of the well-known and admirable "Specialists'" series; and the author is already well-known for an able translation, among other things, of Hospitalier's popular book. Dr. Maier writes in a pleasant and popular way, and he has taken great pains in collecting a large mass of matter. But, we must confess, that after the works of Macgregor and Kapp in this series, the present volume is a great disappointment. It consists mainly of matter that has already appeared elsewhere and is old, and so far from being written for specialists or even by a specialist, the writer has evidently no practical or scientific acquaintance with his subject. The work is very elementary and is intended to be popular, but it is bristling with errors.

The writer, after an introduction in which he takes a very fair view of the prospect of the competition of the electric light with gas, goes on to discuss Joule's and Ohm's laws. Here he comes to grief. Work and power are confused hopelessly on page 11, and whenever they are discussed throughout the book; and force is the term used for energy. A large portion of this part of the book appears to be translated from Merling, who may be responsible for these mistakes and the misuse of scientific terms. About 15 pages are devoted to the discussion of the coupling-up of primary batteries for the electric light, and this part of the book contains a good deal of pseudo mathematics. The question of coupling up cells to get the maximum power or activity seems to have some curious attraction for writers of electrical books. Niaudet probably set the ball rolling in his book on Gramme machines. Niaudet was discussing magneto machines principally, and at that time, when the study of dynamo machines was new, the difference between a magneto machine driven at constant speed, and a set of cells was not well understood. Schellen copied a great deal of this part of Niaudet's book into his book of 1882, and the discussion of arrangement of cells seems to have gone the round of the German text books, getting more confused and more full of pseudo mathematics under the Teutonic treatment. It seems to be spreading over to England now like some infectious disease. It appears in its most virulent form in Paget Higgs's book in the same series. He says that the "efficiency of an electro-generator is greatest when its electromotive force is twice as great as the opposing force that arises whilst the current is doing work." Dr. Maier suffers from an equally deadly attack. He says, page 29, that the "maximum effect is obtained by making the internal resistance of the dynamo equal to the resistance of the external circuit." The same thing appears on page 38. He also informs the specialist on the same page that the electromotive force of a Bunsen element is 1·65 volts; and also that "the work to be expended is, always supposed the current remain constant, theoretically proportionate to the resistance of the circuit." Apart from these errors resulting from misunderstanding the laws of maximum output of cells, the discussion of the arrangement of cells has nothing to do with the subject of which the book would be expected to treat. The writer goes on to discuss dynamos, and gives tables of old tests of obsolete machines that are now of no use to anybody, and are already in everybody's library or lumber-room. All writers on any branch of electric lighting seem to think it necessary to go over the same ground. In Kapp's and Higgs's books in this series alone one has enough about dynamos to make him independent of this part of Dr. Maier's work.

Dr. Maier goes on to discuss measuring instruments. Most of the instruments described by him as in general use are obsolete. Ayrton and Perry's old form of permanent magnet voltmeters and ammeters with the arrangement for calibrating with an ohm plug is not representative in 1886. Lalande's ampèremeter is a resuscitation of Fremonger's galvanometer of 45 years ago. The instruments of Sir W. Thomson, Cardew, Crompton, and Kapp, Cunynghame and the present form of Ayrton and Perry's ammeters and voltmeters are not described.

The author gives a very good descriptive chapter on secondary generators.

At page 140 Dr. Maier begins the real subject of his book. He gives 24 pages of popular description showing how an arc lamp works, and then describes various lamps. Here again there is cause for complaint. Dr. Maier might have gone into the theory of arc lamps. No book has been written in which arc lamps have been fully discussed. Most people probably do not know that these lamps demand any special study, and think that to design one you must merely arrange mechanism to pull the carbons apart at starting, and to prevent the arc getting long enough to break the circuit. Those who have worked out a system of arc lighting, however, know that it is an exceedingly difficult subject. Dr. Maier had here a splendid opportunity of breaking new ground and giving information which is very much wanted. Instead of that he merely gives descriptions of a lot of lamps mostly obsolete or unknown, with illustrations one has known from his youth upwards.

He begins with the Foucault-Duboscq lamp and the usual woodcut. We are sick of the Foucault lamp. We have about 97 different copies of this illustration on our shelves, with an equal number of descriptions all equally unintelligible. We have watched the woodcut with anxiety in the hope that it might at last wear down and become an unintelligible smudge. But no, it appears that an interminable series of electrotypes are being prepared. We must, however, thank Dr. Maier from the inmost recesses of our heart for one thing. He has spared us the Gramme ring with the bit cut out. We read about lamps by Archereau, Jurgensen, Bürgin, &c., which we have never seen in use or heard of outside books. Most of the lamps now in general work are omitted altogether, or described in a manner which could be of no use at

all to a lampmaker. Generally old or obsolete forms of lamps are given. The Crompton lamp described, for instance, is an obsolete type brought out seven years ago. In the chapter on the construction of arc lamps the author says some quaint things. He is much troubled at the foot of page 239 as to whether an arc lamp should have its solenoid in series or shunt. He assumes the coil to be four ohms and the arc two ohms and tries the effect of it as a series lamp. He finds the result unsatisfactory. He then tries the same four ohm coil in shunt and considers this much better. He says the "advantages of the second arrangement require no further demonstration." We would like to see an installation of arc lamps with say a 40-horse dynamo, according to Dr. Maier's ideas. To begin with there would be 20-horse or "20 horse-power per second" spent in the machine itself "in order to obtain favourable results," as our author puts it. There would then be 14 horse-power outside in the leads, and two in the four ohm shunts, and four, or one-tenth of the whole, in the arcs themselves. On page 243 a strange theory of the action due "to the difference of the varying current strength" is elucidated.

Passing to Part III. (glow lamps) we are obliged to wade through regulation descriptions of obsolete semi-incandescent lamps. Here again the author has missed a splendid opportunity.

The various processes of manufacture of incandescent lamps are trade secrets. The result is that little is known about them outside factories. Dr. Maier if he could have written a theoretical and practical treatise on incandescent lamps would have supplied a book that is very much needed. It is scarcely likely that any writer could get the necessary information to write a book giving the details of such a complicated manufacture as that of incandescent lamps; but as many people have odd ideas about the theory of them a writer on that subject could do very good work. Dr. Maier's chapters on glow lamps are merely popular descriptions. He says the substances most commonly used for glow lamp conductors are platinum, iridium, and carbon.

In describing Edison's lamp, Dr. Maier makes some very sensible remarks about the question of high efficiency *versus* long life. It is strange that this matter is so little understood. Dr. Maier also points out that most of the tests of lamps published are unreliable.

The description of the Lane-Fox or Victoria lamp is quite out of date. The present Victoria lamp appears to have a filament made from a solution of cellulose in zinc chloride, and the hair oil flask form with mercury seals shown in the woodcut was abandoned long ago.

In describing Bernstein's lamp, Dr. Maier carefully avoids any advertisement of his own company.

The very common mistake is made of supposing a hollow filament has some advantage over a solid in radiation.

There is no advantage in using a hollow carbon. The author seems to think that in a solid conductor energy is somehow lost in the centre, and that this loss is avoided by removing the centre of the filament. Similarly nothing is gained by making the filament of a flat or any particular section. Again, Bernstein's is not the only lamp with an animal filament. Silk filaments are used in the States.

We have the Vienna lamp tests again at page 296. No doubt if people take the trouble to make all these tests they may as well be printed, but they are not really of any use to anybody. Several pages are devoted to a discussion of glow lamps generally. The writer thinks that a tamadine filament must be weaker than one of vegetable parchment.

Considerable space is devoted to the tests of Siemens and Halske's lamps. These tests are again of very doubtful value. Dr. Maier has some very primitive ideas. He finds from personal experience that such a pump as the Lane-Fox gives infinitely better results than "with pumps with several stopcocks which require greasing, like the Sprengel or Geissler pumps." Does he imagine lamps are generally made with the vacuum at the mercy of greased stopcocks and mercury joints? The rest of the book is devoted mainly to popular descriptions of various installations.

It is, no doubt, very difficult to write a good book, and very easy to run through one and point out errors. The present review may seem unnecessarily severe, but in writing it we do not feel as if we were reviewing Dr. Maier's book alone, but a whole class, which is always increasing. If a list of books on electric lighting is taken up it will be found that most of them are simply compilations of old and valueless matter, with the same descriptions and illustrations over and over again. These books are of no use, and it is quite time the supply should begin to fall off. Every book should be new as to its matter, or as to its treatment of a subject; the sole novelty should not lie in a few original errors. And, above all, a writer should at least understand the subject upon which he writes; further, if he writes on arc and glow lamps in a series ostensibly for specialists, he should at least know as much about arc and glow lamps as those who have to do with them. We must congratulate Dr. Maier on one point, if we may do so without impertinence, and that is on his perfect mastery of our very difficult language.

REPORT ON THE REGENT PRIMARY BATTERY.

I HAVE had submitted to me for examination and test a primary battery called the Regent primary battery, and have carried out experiments upon it at considerable length with the object of ascertaining its character and cost of working.

This battery is a two fluid battery, and consists essentially of an outer containing cell, which may be of glass, porcelain, ebonite, or any other suitable material, and an inner cell of porous clay, rendered more highly conductive by a suitable process. The inventor claims to be able to reduce the electrical resistance of the porous septum without at the same time increasing its porosity to liquids, thus limiting the diffusion, whilst reducing the internal resistance.

The active or positive element of the battery is an alloy, principally consisting of zinc, so treated that the repeated amalgamation which is so troublesome in ordinary batteries is obviated. The plate remains perfectly bright during consumption, and economy of working by the absence of local action is claimed for it. The other element of the battery is a carbon plate or plates immersed in an oxidising solution.

The inventor does not claim special novelty for this oxidising solution, but has arrived by exhaustive experiments at a liquid which combines cheapness with constancy of action, and almost complete freedom from irritating fumes.

It is claimed for the battery that, with the greatest simplicity of structure, it surpasses other similarly simple batteries in constancy of electromotive force, and in cheapness of operation.

Three samples were submitted to me, a single cell about 5 inches by 3¼ by 1¾, a smaller cell about 3¼ inches by 2¼ by 1¼, and a battery of 24 of these last cells contained in a box about 10½ inches by 9½ by 5.

Calling these two sizes of cells the larger and the smaller respectively, we have the following determinations of the constants of each:—

Large cell—Internal resistance ... ... = ·26 ohm.
Electromotive force open circuit = 2·19 volts.
Small cell—Internal resistance ... ... = ·71 ohm.
Electromotive force open circuit = 2·18 volts.

The battery of 24 small cells had an electromotive force of 52 volts on open circuit.

The large cell was first of all set to generate a current through an external resistance of ·845 ohm, and the value of the current and external activity continually measured. It gave an average current of 1·75 ampères for very nearly five hours, the greatest variation of the current strength during the time being only 2 per cent. on either side of this, and the total drop of strength being about 4½ per cent., that is after five hours the current was 95½ per cent. of the original strength. During this time the cell evolved 8·34 ampère hours of current, and energy developed on the external circuit was 12·38 watt hours.

The total consumption of the active plate in the cell was 12 grammes. Hence we may reckon the consumption of the active or positive plate at about 1,000 grammes or 2·2 lbs. per 1,000 watt hours.

In order to ascertain the amount of waste action a similar cell was allowed to stand unused for 24 hours, and the loss in weight of the positive plate determined. It amounted to 5·6 per cent. of the original weight. Hence the average loss by local action is about ¼ per cent. per hour.

Experiments were next made with the small set of 24 cells. It was set up and made to supply current to a 40 volt incandescence lamp. The current and electromotive force at the terminals of

the lamp were measured every five minutes for six hours by corrected instruments. During the first two hours there was a drop in electromotive force amounting to about 5 per cent. From the end of the second hour to the end of the sixth hour the current and electromotive force remained *absolutely constant*, the closest inspection did not reveal any change in the reading of the instruments. This is certainly a very remarkable result for cells of this small size. During this time the battery was delivering energy at the rate of 30 watts, and hence in the six hours run delivered 180 watt hours or about 500,000 foot-pounds of energy.

During this time the consumption of active plates was about 3 ounces weight in all. At the end of the run the positive plates were as bright and untarnished as when first put into the battery.

The glow lamp used gave during this time an illumination of about 12 candles with remarkable steadiness.

The performance of this small battery of 24 cells seemed to me to be worthy of considerable praise. Beginning at 12 o'clock with a current of ·77 ampère, it continued to supply current for two hours at a slightly diminishing rate, falling to ·74 in two hours and then remained nearly constant for four hours more, finally falling to ·735 ampère. During this time it did not evolve any perceptible fumes.

I have ascertained by independent inquiry what would be the cost of charging these 24 cells, and find that the cost of electrical energy obtained from such a battery would be approximately one penny for 40 watt hours. This means that a 16-candle glow lamp could be maintained in action for about six hours for sixpence, as far as concerns the battery and independent of deterioration of the lamp.

Setting on one side central station lighting we may say that domestic incandescence electric lighting by means of gas engine and secondary batteries has now arrived at considerable perfection, and can be carried on at a cost very little, if any, superior to gas lighting. Considering all the enormous advantages of incandescent lighting, we may well ask why such method is not in far more general use, and the reply undoubtedly is, that people shrink from the first cost of such an installation. Granted that for £10 or £15 a year a small house can be lit by incandescence lamps with gas engine, yet if such installation necessitates £200 or £300 initial outlay the demand will be limited. Now there is a considerable field of small domestic lighting in which people desire to have a few lamps in their houses, and which could be met, and met well, by an efficient primary battery.

In order, however, that a primary battery may meet the requirements of the case, it must, in my opinion, comply with several conditions.

1. The plates should not require re-amalgamation. This is costly and troublesome.

2. It must have small local action, or small wasteful consumption on open circuit.

3. The electromotive force should not fall off more than 5 per cent. during the delivery of its normal current in about six or eight hours.

4. There should be no complicated arrangement of pipes and circulation of fluids. These arrangements act well at first, but are excessively liable to get out of order.

5. No mixing of chemicals or strong acids should be required; the exciting solution should be supplied ready mixed and be capable of being put in by any ordinary domestic like oil into a lamp.

Now these conditions are all of them complied with in the Regent primary battery, and in addition such moderate economy in working, that although the lighting by it will not compete with gas, yet nevertheless, all things considered, it is not a cost which will inhibit those from using it who desire the luxury of incandescent lighting, and yet do not desire to incur large initial outlay.

One thing that very greatly recommends such a primary battery as this for such domestic lighting is that it can be used occasionally or whenever required. Now no arrangement in which secondary cells are used can be employed intermittently.

The secondary batteries rapidly deteriorate under these circumstances. A primary battery can be charged and used one day a week, and then, when emptied and cleaned, is ready again for use when required.

In addition, I may say that I regard this alloy as used for the positive plates in the Regent battery as a very valuable invention; with a little modification this battery should have large uses in telegraphy and other operations when a constant battery of high electromotive force is required.

It can be made small, and there will be useful applications of it in small portable electric lamps. On the whole I am very well satisfied indeed with the manner in which this battery has comported itself under tests, and am of opinion that under proper management its use should be very extensive and meet requirements not yet supplied by any existing forms of battery.

J. A. FLEMING, M.A., D.Sc.,
Professor of Electrical Technology in University College, London.

July 9th, 1886.

Electric Lighting at Eastbourne.—The Eastbourne Town Council have decided to accept the local electric light company's tender of £340 for laying the wires and switches and providing the necessary plant in connection with the electric lighting of the New Town Hall.

CAPEL-COURT CURIOS.*

IV.—THE FAURE ELECTRIC ACCUMULATOR COMPANY—A CURIOUS RELIC OF THE ELECTRIC MANIA.

THE wrecks of the electric mania of 1882 are scattered far and wide. Some are still maintaining a moribund kind of existence as manufacturers of lamps and glassware; some have retreated to dingy offices in back streets to wait for better times; a good many have slipped quietly out of life, and their former place knows them no more; a few have passed or are passing through the ordeal of a formal liquidation, and if the Vice-Chancellor's Courts were to tell all their secrets a good deal of financial hair would stand on end. There might also be a considerable amount of fun put in circulation in the City. Many a quaint and merry tale could be told of how electric companies were got up and floated in the brilliant '82. In this connection, the Faure Electric Accumulator Company would prove, I believe, one of the funniest dogs in the lot.

Four years ago there flourished in Brussels a financial promoter and an electric company. The promoter's name was Simon Philippart, and the company had been registered under the comprehensive title of the *Société la Force et la Lumière*. The two were virtually one, for M. Philippart had founded the society and held nearly the whole of its stock. Being his own society he had not thought it necessary to put much money into it, but he had exercised his undoubted right to bestow on it a huge nominal capital—how many millions of francs I cannot say precisely, but a few millions out or in did not matter to M. Philippart. The *Société la Force et la Lumière* had not much visible property, but it possessed an incorporeal asset of priceless value. M. Philippart had stumbled on a French chemist named Faure, who had invented an electric accumulator. After the first flush of triumph over electric lighting, it was found that the dynamo could not be trusted to apply its motive power direct to its object. The slightest vibration in the machinery disturbed the light or the power that was being applied. Steadiness was indispensable, and in order to secure it something had to be interposed between the dynamo and the illuminator. Moreover, electricity, to be thoroughly useful, should be capable of being turned on and off like gas. It wanted a gasometer, in fact—a vessel in which electric power might be stored up and kept ready for instant use. This was what M. Faure claimed to have produced in his accumulator; and M. Philippart, having a keen eye to the speculative value of patents, bought it from him or arranged with him to "exploit" it.

M. Philippart struck vigorously while the electric iron was hot. He was a born promoter—a man of great ingenuity and resource, and, what was of more importance, he was not too good a man for his business. In his time M. Philippart has had a rather varied experience. He has seen ups and downs, and he has tasted the pleasures of bankruptcy; but what great financier has not? When he undertook a scheme, no nonsensical scruples would prevent his doing justice to it. With his accumulator he began operations simultaneously in Paris and London. He spent over £26,000 on machinery and plant for his two little shows. The London one was held at a shop in the Strand, where the wonderful accumulators were exhibited in operation, driving bicycles and sewing-machines in one room, cooking chops and omelettes in another. The morning papers sent reporters to describe the marvellous invention, and of course the reporters were all delighted with it: it is a reporter's business to be delighted with whatever will make good copy and read spicily next day. The more pompous scientific journals smiled on this new triumph of the popular science of the day; they talked learnedly of volts and ampères and peroxides of lead, whereupon the astute Philippart laughed in his sleeve at the thought of the peroxides of British gold which were likely to result from the excitement they were getting up in his favour.

He kept the fire going. Peers and peeresses, Cabinet Ministers and Members of Parliament, actors and aldermen, all flocked to his shop in the Strand to admire the marvellous box which contained the potential energy for lighting a room, cooking a dinner, driving an express train and sewing on buttons. That was a happy time for M. Philippart, marred by only one small drawback: he could not speak to his "Eenglish friends" in their own tongue, or understand their lavish compliments without the help of an interpreter. That was unfortunate—it tasted like sucking a sherry cobbler through an India rubber tube. But M. Philippart was not sentimental: he was keeping his eye on the peroxides of British gold, and the prospect in that respect was very encouraging. By this time the electric mania was in full blast. Father Brush was throwing off brood after brood of chickens. He was selling concessions for £100,000 and £200,000 a-piece as easily as a cheesemonger hands half-pounds of Stilton over his counter; his treasury was bursting with coin and scrip, and his own £5 shares were being run after at nearly £50. M. Philippart smiled grimly and rubbed his hands when he read of the miracles of Father Brush. He, too, would be in that business soon, and when the Faure accumulator had once started to shed concessions, Father Brush might look to his laurels.

There was no difficulty about getting up a company and launching the accumulator with due honours. M. Philippart had his pick of upper-crust directors. None of your seedy baronets or greedy

* *Financial News.*

C

guinea-pigs for him! He had his choice of the best bank boards, railway boards, and insurance boards in the city. Sir Arthur Otway agreed to be his chairman; Sir Charles Clifford, Mr. C. J. Grenfell, and Mr. H. Ranking felt honoured in being asked to sit along with him. For a secretary M. Philippart went to a leading electric family—the Cannings, and Sir Samuel let him have one of his clever nephews. There was quite a crowd of consulting engineers and electricians; the patriarchal Sir William Thomson, whose good nature is hardly inferior to his scientific genius, smiled paternally on the undertaking; Profs. Ayrton and Perry engaged to superintend the construction of the electro-motors. The capital of the company was on a generous scale, worthy of its high scientific and political associations. Nominally, it was £1,000,000, of which £800,000 was to be in ordinary shares of £10 each, and £200,000 in deferred shares of £1 each. The first issue comprised half of the ordinary and half of the deferred capital, that is, £400,000 of the first and £100,000 of the second.

M. Philippart made liberal promises to his subscribers. He never failed in that respect, for promises were cheap with him. If his directors had allowed him he would cheerfully have undertaken that every shareholder in the Faure Electric Accumulator Company should within 12 months have a castle in Spain, a moor in Scotland, and a private box at Drury Lane—all out of dividends. His programme was to make the original company a mother of many children, and with the multitude of its offspring to put Father Brush himself to shame. But the two British baronets had a prejudice against the financial stud scheme. They would not go into it, and M. Philippart, having to choose between his idea and his board, reluctantly gave up the idea, but only for a time. His ardent soul could not brook the thought of wasting precious time in the manufacture of accumulators, when it was so much easier and more profitable to sell ready-made concessions. M. Philippart, you will observe, was a financier, and he stuck to finance.

Under the restraining influence of his board he moderated his liberality to the shareholders into a promise of 10 per cent. cumulative dividends on the amount paid up at the time of distribution. Afterwards the deferred shares were to come in for 10 per cent., and then the boundless surplus was to be equally divided between them. On this basis £40,000 shares were offered to the public, and about one half of the issue was taken up; £2 was called on each share, making nearly £40,000 in cash that the company started with. Subsequently M. Philippart, through a benevolent jobber in the Stock Exchange, got hold of the unissued 20,000 shares, and paid £2 per share on them, making another £40,000. But the one balance sheet published by the company does not distinguish actually-paid-up from nominally-paid-up capital, and it is hard to say how much hard cash the company fingered in the course of its brief and brilliant career. The sum cannot, however, have been less than £80,000. Before the end of its second year it went into liquidation with a balance at its bankers of about £300. It had not made a single installation except for advertising purposes, and these cost it nearly £9,000; it had not sold a dozen accumulators to *bonâ fide* purchasers. When the smash came it had nothing tangible to show for its capital, save its office furniture and the few hundred pounds left at the bank.

Where the £80,000 went is a mystery. £25,000 of it went to M. Philippart in part payment for the patent; "brokerage upon allotment and law charges" swallowed £6,418, so that the Stock Exchange was not shabbily treated; the lighting of a Pullman car on the Brighton Railway, of the Grand Hotel at Charing Cross, and one or two smaller experiments entailed a loss of £8,887; the directors, managers, engineers and staff got £7,910, and in the course of their arduous duties they consumed stationery and "sundries" to the value of £806 11s. 9d. In order not to leave the shareholders out in the cold when these benevolences were going, they were paid £6,000 of their own money by way of interim dividend. One of the last acts of the Philippart administration was to sell off the machinery and plant, both in London and Paris, and the loss incurred on it was about £3,600. Financially a very brilliant record, showing nearly £60,000 spent on floating and advertising this marvellous invention, and keeping it in life for a couple of years.

The Faure accumulator was a choice example of the value of a disputed patent. From the day the patent rights for England were bought by this unlucky company till they were sold again to another of M. Philippart's joint-stock aliases they were in a maze of litigation and reorganisation. The company spent its whole life in transforming and reconstituting itself. The board soon found that they would have enough to do looking after the irrepressible M. Philippart, and fighting the new proposals he was continually making. Even if they had had the means to manufacture accumulators, and a market to sell them in, M. Philippart would have given them no peace to do it. At every board meeting he started something novel and unexpected—an agreement with some rival company or a fresh manipulation of the shares or a new departure of some kind. One day he was all for war on other patentees as robbers and infringers; next day he had come to terms with the enemy, and was all for "harmony of interests." Before the patent had been well registered there were half-a-dozen Richmonds in the field: Volckmar, Sellon and Swan all had accumulators on show, which they claimed to be a century or more in advance of Faure. How amusing it is now to read again the ecstatic accounts which were given in the papers of their respective achievements, and the glowing predictions indulged in as to their future! No less amusing is it to get a glimpse of what was all the while going on behind the scenes. Salting a mine or "nursing" a racehorse is an innocent device compared with manipulating patents for the financial market.

Some funny things happened in the course of that now-forgotten war of the accumulators. The first competitor who gave serious trouble was Volckmar. He had for a confederate M. Philippart's own son, but Philippart was a Roman father, and did not allow paternal feelings to interfere with business. He alleged that Volckmar had made use of his position as an assistant in Faure's laboratory to steal his master's ideas. Such dishonesty should be put a stop to at once, and before Volckmar's accumulator had been seen out of France M. Philippart wished the English company to take proceedings against him in Paris—to pull M. Philippart's chesnuts out of the fire for him, in short. When Volckmar did come over to this country, he very cleverly guarded his flank against the Faure people by entering into alliance, offensive and defensive, with the Sellon and Swan parties: the three entered into a strong combination under the name of the Electrical Power Storage Company.

Keen as M. Philippart has been for fighting, there was more of it here than he had appetite for. It was not going to suit a wholesale dealer in concessions to have several patent suits on hand. The next best thing to a good war being a good peace, M. Philippart, without saying anything to his directors, opened negotiations with the enemy, and made a treaty with them for a friendly division of the electrical world. They made the world, in fact, their oyster, and M. Philippart took one half, while Volckmar, Sellon and Swan got the other. The Faure Company was to have a monopoly of what may be called domestic service—namely, lighting of houses and of ships in harbour, and driving of private machines, such as bicycles, pleasure boats, &c. The Volckmar-Sellon-Swan Company appropriated all the public service, lighting of halls, driving of omnibuses, railway trains, and so forth. For its special purposes the Faure Company was to have the benefit of the Volckmar-Sellon-Swan patents in the United Kingdom, and reciprocally the Volckmar Company was to have the benefit of the Faure patents outside of the United Kingdom. The value of these respective concessions was duly assessed, and was to be paid for by an exchange of shares. The Faure Company was to hand over to the Volckmar-Sellon Company £200,000 of its precious capital fully paid up, and the *quid pro quo* of the Volckmar-Sellon people was to be £60,000 of their shares fully paid up.

M. Phillipart brought this amusing agreement to his directors nicely cut and dried, and asked them to submit it to the shareholders for their approval. It did not by any means commend itself to the board, but, with the breaking up of the company before their eyes as the only alternative, they thought it would be the smaller of two evils. In June, 1882, it was adopted at a special general meeting, not 1 in 10 of the 500 shareholders having the slightest suspicion of what was behind it. M. Philippart was not satisfied yet. The directors wanted to set to work manufacturing accumulators and putting them in use, but M. Philippart disdained the mere industrial part of the business. He would hear of nothing but "prompt and large dividends," after the fashion of Father Brush. In order to control the board he claimed a seat on it, which the directors very properly refused him. Then he asked to have the 20,000 unissued shares allotted him. This also they refused, as it would have made him master of the company. But he was not to be denied. He went to a large jobber on the Stock Exchange, and got him to apply for the shares. They were allotted to the jobber, who held them on Philippart's behalf until the latter one day smuggled through a transfer of them to himself when the board was nodding, as boards will do occasionally. After getting the shares transferred to his own name, he availed himself of his position as chairman and autocrat of the undertaking to avoid paying his calls.

It may be some consolation now for the shareholders to learn that he had to pay through the nose for many of the shares which he bought up when he was trying to get control of the company. When his rig began the £2 shares were practically unsaleable, but his buying ran them up to £7 or £8. Some of the original subscribers had the shrewdness at this stage of the proceedings to return to M. Philippart his dubious wares at a handsome profit. They were the only people who made anything out of the Faure Electric Accumulator. Meanwhile the swopping of jackets with the Electrical Power Storage Company had resulted in very little beyond a muddle of cross entries in the books. No actual exchange of shares appears ever to have been made, but the Faure Company conscientiously debited itself with £200,000 due to the Electrical Power Company and took credit for £60,000 as due from the latter.

M. Philippart had no sooner got one transformation off his hands than he started two or three more. His next was a triple alliance between London, Paris, and Brussels. In each of these cities he had now obedient tools duly registered as joint-stock companies. In London, M. Philippart was the Faure Electric Accumulator; in Brussels he was the *Société la Force et la Lumière;* in Paris he was the French Electrical Power Storage Company. His next move was to have all three of them tied up in a knot so complicated that the one could not be distinguished from the other. For this purpose he devised three most extraordinary agreements. By the first he made the Faure Company transfer to the English Electrical Power Storage Company all its remaining rights in the United Kingdom; by the second he made the Faure Company purchase from the *Société la Force et la Lumière* its rights and interests in the French Electrical Power Storage Company; by the third, the Faure Company was to sell

to the French Electrical Power Storage Company all its property in Paris. The one clear and definite point in this tangle of contracts and contracts was that the Faure Company denuded itself of all its rights in the United Kingdom—ceased, in short, to be an English company for any practical or honest purpose. Ostensibly it acquired in exchange 92 per cent. of the rights and interests of the Volckmar-Sellon Company in France and the French colonies, but that was represented only by shares in M. Philippart's French Electrical Storage Company, an association whose legal status was at the time and still is very doubtful. In the solitary balance sheet ever submitted to the Faure shareholders these French shares were valued at £774,000, and they made the Faure Company a very Crœsus in scrip! But I doubt if M. Philippart ever found time to get the share certificates printed.

He had now tried the patience of his English directors to breaking point. They intimated to the shareholders their disapproval of these Arabian Nights agreements, but promised to submit them formally to a special meeting on the understanding that if they were adopted the board would retire. M. Philippart never spared birdlime when he was on a snaring expedition. It is ludicrous now to read the golden expectations with which he fed his dupes. He issued printed circulars, offering, in the event of the resolution being carried, to give a fully paid up £10 share for every two shares with £2 paid. He thought the shareholders would be pleased also to learn that "we shall be able to pay in the month of January next a dividend at the rate of 10 per cent. per annum from the date of issue upon the £2 paid on our 40,000 ordinary shares." Any common place joint stock juggler might have thrown out a bait like that, but M. Philippart showed his genius in the postscript which he tacked on to it: "Let me add," he said, "that I have cogent reasons for stating that during the month of February next we shall be able to declare a further dividend of at least £4 per share, and that I hope for still greater things." When he wrote this, Philippart was virtually insolvent, and in less than eight months he—or his creditors—had to seek the protection of the bankruptcy court.

Outrageously high seasoned as was the bait, it caught its gudgeon, and M. Philippart had his resolutions adopted by acclamation. His British directors resigned, and he put in a French board, making himself chairman. This was about the end of 1882, and for the next six months the business of the Faure Company was conducted in a very humorous style. The head office remained in London, but the directors held their meetings in Paris. M. Philippart sent over to the English secretary memoranda of what he wished to be entered in the minutes; these were engrossed in the minute-book, and sent back again to Paris to be signed by the directors! The joke might have gone on long enough had not M. Philippart's creditors cut it short by making him bankrupt. Immediately after that untoward event the whole French board resigned, and the company was for a time without any directors. A few of the shareholders met to consider the situation, and they decided to file a petition for voluntary winding up. Before they could go into court, however, they had to appoint a new board under a special provision of the Joint Stock Act. Since then Faure's Electric Accumulator Company has been slumbering through the last stage of its existence in liquidation. It has taken months and even years to unravel the intricate story of its transformations and its disguises. And yet there are people who sneer at the City as prosaic and having no sentiment or romance in it! Where is the magazine romancer who could imagine adventures like those of M. Philippart—so grandiose, so impudent, and withal so comic?

REPORT ON THE EXPERIMENTS OF M. MARCEL DEPREZ RELATING TO THE TRANSMISSION OF POWER BETWEEN CREIL AND PARIS.

By M. MAURICE LEVY.

(*Concluded from page* 193.)

THIS price has been given as a simple indication. M. Deprez considers that it will be signally diminished in consequence of the regular manufacture of the machines, as also by important improvements which he calculates on introducing, taking into account the instruction derived from the present experiments.

9. From a scientific point of view these experiments seem to reduce to nothing, or to a mere trifle, the effects of self-induction which seemed likely to result from the sudden changes of polarity produced twice per revolution as each wire passes by the brushes. They show, also, that with careful construction Foucault currents may be avoided, even in the largest machines.

Lastly, they confirm the laws of electro-dynamic induction far beyond the limits reached in former experiments.

I add that the report of the Commission concludes with these words: "The Commission, in the name of science and industry, warmly congratulates M. Marcel Deprez on the admirable results which he has obtained. It expresses its gratitude to MM. de Rothschild for the exhaustless generosity with which they have supported this gigantic experiment."

TABLE I.

Number.....	1.		2.		3.		4.		5.	
	Creil.	Paris.	Creil.	Paris.	Creil.	Paris.	Creil.	Paris.	Creil.	Paris.
Hours	$10^h.20$	...	$10^h.30$	...	$10^h.40$	...	$11^h.00$	...	$11^h.10$	...
Intensity: Deviation of the galvanometer: K = (Creil K VI = 0·300) (Paris K V = 0·222) ...	22·93	30·75	25·18	33·50	27·43	36·50	30·43	40·25	32·93	44·25
Intensity in ampères	$6^a.879$	$6^a.827$	$7^a.554$	$7^a.437$	$8^a.229$	$8^a.103$	$9^a.129$	$8^a.936$	$9^a.879$	$9^a.824$
Mean intensity	6·85		7·50		8·17		9·25		9·85	
Electromotive force: Deflection of the potentiometer: K = (Creil K IX = 164°·5) (Paris K II = 129 °·3) ...	28·50	32·20	30·37	35·50	32·62	37·40	34·75	39·20	36·50	42·20
Potential at terminals	4688^{vol}	4163^{vol}	4996^{vol}	4526^{vol}	5366^{vol}	4836^{vol}	5716^{vol}	5069^{vol}	6004^{vol}	5456^{vol}
Electromotive force	4887	3902	5215	4242	5605	4527	5981	4711	6290	5081
Magnetic field: Deviation of galvanometer: K = (Creil K VII = 1·027) (Paris K IV = 1·106) ...	30·25	25·00	31·00	26·50	30·25	27·50	33·50	29·00	35·35	31·00
Intensity in ampères	31·07	27·65	31·84	29·31	31·07	30·42	34·40	32·07	36·30	34·29
Electric work in H.P.	7·54	3·97	7·92	4·46	7·54	4·81	9·25	5·34	10·30	6·11
Number n turns per minute	168	244	182	257	199	267	206	278	218	295
Sum y of ordinates of dynamometer ...	171·5	...	181	...	188	...	213	...	228	...
Abscissæ x of dynamometer	84	...	92	...	99	...	...	...	...	...
Dynamometric work at generator ($T_m = \frac{x\,y}{216}$ in horse-powers)	66·7	...	77·1	...	86·1	...	102	...	116	...
Charge P at brake of recipient (L = 2 m. 30, arm of lever of brake)	...	35^k	...	40^k	...	45^k	...	50^k	...	55^k
Useful mechanical work of recipient given by brake ($T_u = \frac{2\,w\,L\,n\,P}{60 \times 75}$ in horse powers)	...	27·2	...	32·8	...	38·6	...	44·8	...	52
Industrial mechanical yield	40·78		42·54		48·3		43·92		44·81	

NOTES.—A deflection of 1° of the galvanometer signifies K ampères.

A deflection of 1° of the potentiometer signifies K volts.

The formula $T_m = \frac{x\,y}{216}$ results from the calibration of the dynamometers.

TABLE III.—EXPERIMENTS ON THE WORKING OF THE EXCITER AND THE TRANSMISSIONS.

Position of the driving belt on the cones.	Number of turns of the transmissions per minute.	Work on the motor axle measured at the dynamometers.					Work absorbed by the exciter in action, $a-b$.	Number of turns per minute of the generator and the large cone.	Number of turns per minute of small cone.		Number of turns per minute.		Exciter.				Observations.
		Number of turns of the dynamometers, K mm.	Total ordinates of the registers, y mm.	Band of the exciter let down.	Band of the exciter put on.								Work furnished by the magnetic field of the generator $C = \frac{R\,I}{75\,g}$.				
					Circuit open, b.	Circuit closed, a.			Theoretical.	Experimental.	Theoretical.	Experimental.	Number of divisions of galvanometer, n.	Intensity of current, $I = n\,K$.	Resistances of the conductors of the generator, R.	C.	
				h.p.	h.p.	h.p.	h.p.						d	A	W	h.p.	
1	52	78	16·5	5·95	...	...	...	156	170·5	170	...	...	...	...	...	...	K = 1·93 (coefficient of the galvanometer). Cones connected by bands so as to vary the speed of the exciter. *1st series of experiments.* Pulley of 200 millimetres fixed on shaft of the exciter.
1	52·2	78·5	18	...	6·54	...	...	157·5	172·2	172	1002	972	...	...	...	...	
1	52·1	78·2	50	...	...	18·10	11·56	157	172	172	1002	951	31·25	32·2	7	9·86	
2	...	...	...	6·28	...	...	...	...	...	...	...	...	...	...	...	...	
2	...	...	...	...	7·04	...	...	...	...	...	...	...	...	...	...	...	
2	52·5	79	66	...	...	24·14	17·10	156	200	198	1155	1116	37·5	38·6	7	14·2	
3	51·2	77	18·2	6·59	...	...	...	155	236	237	...	...	...	...	...	...	
3	...	...	...	...	7·54	...	...	...	...	...	...	...	...	...	...	...	
3	52·1	78·2	90·3	...	...	34·08	26·54	158	240	236	1376	1341	46	47·4	7	21·3	
5	51·6	77·5	19·3	6·92	...	...	...	154	334	339	...	...	...	...	...	...	
5	52·1	78·5	23·5	...	8·54	...	...	155	336	330	1925	1920	...	...	...	...	
1	67·5	101	17·5	8·17	...	...	...	204	224	224	...	...	...	...	...	...	*2nd series of experiments.* Pulley of 300 millimetres fixed on shaft of exciter.
1	68	102	18	...	8·49	...	...	204	224	224	870	868	...	...	...	...	
1	68	102	34	...	...	16·06	7·57	205	224·5	224	858	858	27·25	28·1	7	7·5	
2	...	...	...	8·38	...	...	...	...	...	...	...	...	...	...	...	...	
2	69·2	104	19·5	...	9·38	...	...	208	267·5	267	1070	1052	...	...	...	...	
2	68·2	102·5	46·5	...	...	22·06	12·68	205	263·5	260	1010	1010	35	36	7	12·3	
3	68	102	18	8·50	...	...	...	203	307	307	...	...	...	...	...	...	
3	67·5	101	20·5	...	9·58	...	...	203	307	306	1190	1185	...	...	...	...	
3	67·5	101	62·5	...	...	29·25	19·67	204	308	305	1185	1163	42	43·3	7	17·8	
1	100	151	21·05	14·65	...	...	...	306	335	334	...	...	...	...	...	...	*3rd series of experiments.*

TABLE II.

MEASUREMENTS MADE BY THE COMMISSION OF INVESTIGATION.

Resistances.

Generator	Rings	29·00 ohms.
	Inductors	5·75 „
Recipient	Rings	38·18 „
	Inductors	3·82 „
Line		97·45 „
Exciter at Creil (ring and inductors in series)		1·26 „

Exciter at La Chapelle.—It has a double wrapping on the inductors: one of thick wire in the circuit formed by the ring and inductors in the circuit formed by the recipient, and one of fine wire in derivation.

Ring	0·28 ohms.
Wrapping of thick wire	0·12 „
Wrapping of fine wire	27·81 „

After this report had been read M. Deprez thanked his colleagues, MM. J. Bertrand, E. Becquerel, and A. Cornu, for the active part they have taken in the researches of which M. Lévy had just given so clear and thorough an analysis.

He took, also, the occasion of expressing his obligations to his coadjutors M. Sarcia, the engineer charged with the construction of the machines, and the direction of the station at Creil; M. Geraldy, engineer of bridges and highways, who was charged with the direction of the station at Paris; M. Minet, charged with the graduation and the control of the instruments for electric measurement; MM. Duché and Clémenceau who superintended the measurements and the inspection of the machines.

He also expressed his gratitude to MM. de Rothschild, without whose generous assistance so extensive an experiment could never have been made.—*Comptes Rendus.*

Electric Lighting at a Flower Show.—At the Workmans' Annual Flower Show held last week at the Plymouth Works, near Merthyr, the electric light on the incandescent system was shown to great advantage and proved quite an attraction to the hundreds of visitors present. In all over 100 16-C.P. lamps were in use, hung from silk-covered flexible wire with Venetian blue and ruby shades. In the evening the grounds were also brilliantly illuminated. The work was carried out by J. C. Howell, of Llanelly, agent for Messrs. Crompton & Co.

INCANDESCENT LAMP PATENTS.

EDISON *v.* WOODHOUSE AND RAWSON
AND
EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY *v.* WOODHOUSE AND RAWSON.

(*Before* MR. JUSTICE BUTT, *sitting for* MR. JUSTICE NORTH.)

(*Continued from page* 196.)

Wednesday, May 19th, 1886—(continued).

MR. JUSTICE BUTT: One observation struck me very strongly on Pulvermacher's specification, and it is this, that when he is dealing with arc lighting ——

MR. ASTON: Which he is altogether.

MR. JUSTICE BUTT: No, no, he is not. He uses and suggests this carbon spiral. But in a subsequent part of his specification he deals with the arc of an incandescent light, and then he drops his rod spiral altogether and takes platinum wire. If Pulvermacher thought it was available for incandescent lighting it is very odd that he should have left it out when he came to deal with that and substituted platinum wire.

MR. ASTON: That is clearly so, my lord, and it is a most pertinent question. If it be true that Pulvermacher's own rod spiral was so suggestive, how came it that in his specification he did not use it? Now, my lord, let me draw from that this, which I think is a very fair inference. The public went to Pulvermacher to read how to make an incandescent lamp. They read the description of a rod spiral as applied to an arc lamp; they went on and read of an incandescent lamp. In the incandescent lamp carbon was rejected, as many an inventor had rejected it before. What did the public say? Here was Pulvermacher, a learned man for all they knew, and this man told them to use carbon in his arc lamp, but for heaven's sake don't use it in the incandescent lamp. He said use carbon where you can, in the arc lamp, but don't attempt to put yourself in the list of those failures that have endeavoured to use carbon in the incandescent lamp. Why? The only carbon known at that time was the carbon obtained from gas retorts, a rigid substance. The only way they knew of pencils being made (if they excepted Sidot's) was by whittling down, by sawing and filing cylindrical or rhomboidal pieces of gas retort carbon. His specification was not a direction for using a carbon rod in an incandescent lamp, but a warning against it. That was the inference to be drawn from Pulvermacher. Upon the authorities, if Sidot's filaments had been sold in the market, or if Pulvermacher's spirals had been detached things exposed in shops for sale, which was carrying the case far beyond what his friends said, even then the insertion of the carbon filament in an

electric lamp as described by Edison would be good subject matter. He would refer to a parallel case, the case of the duplex safety lamp. The duplex lamp was made by placing two wicks side by side which were made to mutually assist each other in giving light. Prior to the date of the patent to which he was going to call attention, there had been an attempt made to manufacture a duplex lamp, and it was made by taking a known wick of a round shape, putting it in a known wick case, which was round, and putting two of them side by side in a lamp. That was held by Sir George Jessel not to anticipate a lamp wherein the wicks were flat. Round wicks known, flat wicks known, both of them known for paraffin, petroleum, or hydro-carbon lamps; but, said the learned judge, "I hold that it was good subject matter to take a known form of wick, the flat wick, and put it in a known form of lamp, instead of the round wick." The case was that of Hincks *v.* The Safety Lighting Company, and was reported in Law Reports, Chancery Division, vol. IV., p. 615. "The only material difference between the two patents was this, that one used a round wick and the other a flat wick. On the one hand it was said, you can never support a patent by substituting a round for a flat wick; there is no invention in that. On the other hand, it was said, Why not, if it is a combination patent? The very essence of a combination patent is that it is a new combination of known parts, and in fact very few machines are now invented which contain any new part. As a general rule every machine invented is made up of parts which are previously known; a new part of a machine is very uncommon indeed. Consequently that is an objection which *per se* is not of great weight. But like every combination which is new, it must have merit; and now how is a judge to apportion that merit. I do not know. As far as I can ascertain from the authorities the merit very much depends upon the result produced. Where a slight alteration in a combination turns that which was practically useless before into that which is very useful and very important, judges have considered that though the invention was small, yet the result was so great as fairly to be the subject of a patent, and as far as a rough test goes I know no better." His lordship held that as good subject matter. Round wicks known in a duplex lamp, flat wicks known in a single lamp, both articles made and sold in the market. Why not take the flat wick? Because among a number of things which had failed, this invention told the purchaser the right thing, told you out of 21 things that had failed, to take the 21st and it would succeed; and that was subject matter for a patent. His friends asked him: You say that a person can be prevented from taking Swan's carbon rod and making that into a filament? Yes, he could, on the authority of the case he had just cited. And what was more, if filaments had been sold in the market and nobody had thought of taking them and putting them into a lamp, that would support the patent. Why? Because lamps prior to that were not a success, whereas now incandescent lamps with a filament were used all over the country and were a success. Suppose Sidot had described all the defendants' said, and Edison had said, go to Sidot and take the filament he describes and put it in my lamps, that would have been a patent. That had been decided. There was a well-known case, that of Crane *v.* Price, reported in Mr. Webster's Patent Reports, vol. I., p. 401. In that case the Lords Justices said: "We are of opinion that if the results produced by such a combination is either a new article or a better article, or a cheaper article, than that produced before by the old method, then such combination is an invention or manufacture intended by the statute, and may well become the subject of a patent." It was also held that there might be a valid patent for a combination of materials previously in use for the same purpose, and even for a new method of applying such a purpose, but the specification must clearly express that it is for a combination.

Mr. JUSTICE BUTT: It only comes to this, does it not, that you may have a combination of known things for a patent. It is no answer to say the things were known. That is all you say, is it not?

Mr. ASTON: If used in a way that enables a more beneficial result to the public, that is the subject of a good patent. My friend says there must be some invention in the matter.

Mr. JUSTICE BUTT: I am not quite sure that he is not right. The invention, I suppose, is in combining them?

The SOLICITOR-GENERAL: I have said nothing of the kind. I have admitted that if they described a new form of carbon burner that would be a subject for a patent.

Mr. ASTON: If an invention be new and useful to the public, it is not material whether it be the result of long experiments or profound research, or whether it be brought about by some lucky thought or mere accidental discovery.

Mr. JUSTICE BUTT: I suppose it would do for your purpose to admit even—I do not say it would do—that the conductor used by Edison is not new?

Mr. ASTON: It would, my lord, but I am not saying it. My case would still be strong.

Mr. JUSTICE BUTT: If you admit that it is the same thing that Swan used, then there would be a difficulty. But apart from that lamp—assuming that every part was old?

The SOLICITOR-GENERAL: There would be no difficulty, my lord.

Mr. ASTON: I am apparently labouring points which I now understand the Solicitor-General does not contest.

Mr. JUSTICE BUTT: I do not know that the Solicitor-General admits that; but unless you have Swan's lamp, I don't see any such combination in any of the alleged anticipations as would invalidate this patent, even if a filament were known.

Mr. ASTON: Certainly not. And, therefore, I get rid of Pulvermacher and Sidot, and others.

The luncheon interval here intervened. Upon the resumption of the court

Mr. ASTON continued his argument, and referred to several cases bearing upon the points at issue. Coming to Swan's lamp, he said it was very curious that nobody had produced a reduplication of that lamp, which was used, as he submitted, experimentally. No one had said that the lamp produced in court, and which was the counterpart of Swan's, was a commercially useful lamp that would answer the purpose required by incandescent lighting. He believed the lamps in court were Swan lamps. Were they carbon rods or coiled filaments? They had seen them lighted, they had seen them gradually become dark red and then white with intense heat. Without at all departing from the line which had been taken as the accepted line of argument, he thought he was justified in putting this question to his friends, How came it that no one had ventured to reduplicate the Swan lamp and to show that the results of failure which were referred to in the lecture, the bending of the carbon rod, and the destruction of the terminals, had been overcome?

The SOLICITOR-GENERAL: There is Bernstein's.

Mr. ASTON said they had not had Bernstein's there, and he did not know what compensation Bernstein had for the difficulty of the carbon rod. But he did know this, that if it were true, as stated by the Solicitor-General, that the command of the carbon filament, if supported in law, gave the plaintiff in this action the command of the incandescent lamp market, was it not natural that Mr. Bernstein and a dozen other gentlemen would be very glad to fall back upon the carbon rods which were not claimed by Edison. But how were they to know in what way that arose? He would like to know in what way the use of the rigid carbon rod, with all its attendant inconveniences, its want of stability, its difficulty with regard to rapidity of expansion and deterioration—he would like to know how these were compensated for. He did not know. Nobody had told them, and therefore the reference to Bernstein was a little beside the point. Swan's lamp had not been reduplicated; if it had, Swan's results would have been obtained. What did Mr. Swan say? In February, 1879, the problem had not been solved. "We shall get it by-and-bye;" and no doubt he had in his mind that which he (Mr. Aston) believed he independently discovered. If there had been no Edison he had not a shadow of a doubt, if one might read between the lines, that Swan would have solved the problem; but he had not solved it in 1878 or 1879, nor when he gave his lecture in December, 1879. He had solved it, however, when he came to his patent in 1880, and, very likely, solved it independently; but that did not militate against the validity of Edison's patent. Why? Because Edison gave the public directions which, if followed, would produce a good incandescent lamp. Mr. Aston once more read Edison's directions, and contended it was no use saying that Edison did not tell you to run the pumps; he says, get the best exhaust you can; and every one of the witnesses said that people in November, 1879, knew how to get a good exhaust.

Mr. JUSTICE BUTT: I presume it is necessary for your purpose that Edison's specification involves, or really expresses, what is tantamount to it, that you must use the process of running the pumps? If so, where do we find it?

Mr. ASTON said Edison's patent did not in terms include running the pumps, because there was no express direction. But the utility was admitted. He was ready to put into the witness box witnesses who would hold up certain lamps and say "These are are made according to Edison's patent without running the pumps." A good vacuum was capable of being obtained such as would be an equivalent. Edison said you must have a glass globe which must be exhausted to one-millionth of an atmosphere.

Mr. JUSTICE BUTT: Can you get that without running the pumps?

Mr. ASTON: Yes, my lord. I am going to put it alternatively. Edison does not patent or include in his patent any form of exhaust. He only says, get the best vacuum you can. He did not think Edison claimed *per se* any form of carbon filament; but he said get the best carbon filament you can, and I will tell you half a dozen ways of doing it. Get your glass globe, put into that the best carbon filament you can get. It must be a carbon filament such as is described in the specification, and which is capable of being wound into a spiral. It must have so much flexibility——

Mr. JUSTICE BUTT: I want to know what your contention is, whether it is part of it that running on the pumps is included in the patent. You may say, yes it is, because he directs you to get the most perfect vacuum you can, and that involves to a man who is competent the running of the pumps; or you may say, it is no part of his patent, because he could get a good vacuum without it. But it is not competent for you to say both.

Mr. ASTON: I think so, my lord, because in neither case would the public be deceived.

Mr. JUSTICE BUTT: How does the evidence stand? Is there evidence that if you do not use the Sprengel pump the Edison lamp would be available?

Mr. ASTON: Yes, there is.

Mr. JUSTICE BUTT: Where is that evidence?

Mr. ASTON: In this way. The specification does, as I submit by implication, give you the direction to use the Sprengel pump, and of running the pumps as well. That is to say, to have the hot exhaust. If it includes that, why then you have not only the best vacuum of the millionth part of an atmosphere, but you keep it at that, or thereabouts. On the other hand, if your lord-

ship should hold that the directions—get the best vacuum you can—are not sufficient directions without running the pumps, then I say the specification is sufficient, because the utility of the invention as described in the specification is admitted, and if not admitted we were in a position to prove that lamps made without the hot exhaust will answer the purpose.

The SOLICITOR-GENERAL: For a short time. They do not last so long.

Mr. ASTON: That is quite right. They last a certain time, but their duration is not so long. I invite your lordship, when you come to construe the specification to say that Edison directed the best available vacuum to be used in his lamp, as far as public knowledge went, on November 10th, 1879. That is my answer, my lord, that Edison, when he speaks of the vacuum here, warns the public, in making my incandescent lamp, mind you, you must have your vessel entirely of glass and you must exhaust it in the best way that is known.

Mr. JUSTICE BUTT: I do not quite know what Dr. Odling meant, but he said this in cross-examination, a competent electrician would have no difficulty in exhausting the globe from Edison's specification.

The SOLICITOR-GENERAL: But then your lordship must understand that running the pumps is not for the exhaustion.

Mr. JUSTICE BUTT: I thought it was.

Mr. ASTON: Even if Edison's specification does not sufficiently reveal the process of running on the pumps, yet his specification is sufficient for obtaining a vacuum.

Mr. JUSTICE BUTT: Ought it not to say, continuing the exhaustion? You may have the best possible vacuum to start with, and then in a few minutes your lamp go out, unless you told the public in making the lamps to continue the exhaustion.

Mr. ASTON: I believe the proper way to interpret that is to impart into it that which was public knowledge. The exhaustion by running the pumps was known; and the utility is not denied.

The shorthand notes of the evidence having been referred to and read,

Mr. ASTON said he could not deny that, in the face of that manifest construction of Edison's patent, with the admitted fact of public knowledge, his friends would be in a fearfully strong position with regard to some of the other patents in this case. He did not say that according to instructions received; there might have been an answer. His contention was that Edison told all the world, get the best vacuum you can, and Professor Jamieson said they knew how to do it by getting a Sprengel pump and the best exhaust. Continuing, Mr. Aston said he relied on the case of Hincks and the Safety Lamp Company. There you had distinctly stated that an old wick was put in an old case in substitution for another wick in another case, the only difference being a difference in the form of the wick—both flexible, one flat and the other round. He asked his lordship to say there was a difference in character and in utility with reference to the filament as compared with the carbon rod. One was rigid and liable to disintegration; the other was flexible and resisted what would disintegrate the carbon rod by reason of its flexibility.

The SOLICITOR-GENERAL: There is not a word in Edison's specification about this disintegration.

Mr. ASTON said it was only necessary to draw the proper conclusions. If it were true that owing to rigidity you got liability to fracture, what greater disintegration could you get than that? If it was a new invention to substitute a known flat wick for a known round wick, *a fortiori* it was good subject matter to substitute for a stiff carbon rod liable to be distorted and bent and injured under excessive heat, a carbon filament which owing to its flexibility was not likely to be broken, injured, or disintegrated. The combination here claimed was a new combination, it was a new carbon conductor which was put into the lamp, because it was new in form, it was new in character, and new in the advantages which it presented. There was one objection which the Solicitor-General rather lightly touched upon, as to which he (Mr. Aston) did not remember that any evidence was given, and that was that there was a species of *malafides* on the part of Mr. Edison, inasmuch as he did not refer to the mode of carbonising, which formed the subject of an intermediate patent.

The SOLICITOR-GENERAL: I called it, and repeated it, insufficient specification.

Mr. JUSTICE BUTT: I do not know that *malafides* was imputed.

Mr. ASTON said he had two answers to that. First of all, Edison's patent was not for an improved construction of carbon filament, but it was for the use of the best carbon filament that could be obtained in his lamp. It was true that Edison described in his specification various modes of manufacturing his carbon filament, but in his provisional specification, to which he was obliged to adhere, he did not make the manufacture of the carbon filament a part of his invention. And he submitted that if Mr. Edison had described as part of his invention in his complete specification this improved manufacture of his carbon filament he would have fallen into the difficulty that rendered Edison's patent for the telephone bad. In Edison's case, his lordship knew, and his friends knew very well, he referred in his complete specification to his phonograph; in his provisional specification he did not refer to the phonograph, consequently he had no business to include in his complete specification that which was in excess of his provisional. Therefore Edison would have rendered himself liable to the charge of the invalidity of his patent had he gone beyond his provisional. His lordship would agree with him that there was in that provisional specification nothing which showed that the form of his filament, save as regarded its being of that flexible character—nothing as regarded the mode of making it—was indicated as forming part of the invention, because he said the specification related to his patent 2,402 of 1879, and the invention related to lamps of a similar character, except that carbon thread or strips were used instead of metallic wires. He said his invention now consisted in taking his prior lamp and substituting for the metallic wires carbon wires, which he afterwards more accurately described as filaments. He then referred to the way in which he might form the carbon wire or filament, and he gave four or five different ways. But these were old; he did not describe new things; he merely said, form your thread in this way, and when you have formed it, carbonise it. Therefore there was no invention *qua* formation of threads. Did his complete specification agree with that? The object was to produce electric lamps giving light by incandescence, which should have high resistance. The invention consisted in giving a body of carbon wire coiled or arranged in such a manner as to offer great resistance to the passage of the electric current and at the same time present a slight surface from which radiation could take place. Now they had done with the carbon so far. The invention further consisted in placing such light-giving body of great resistance in a perfect vacuum to prevent oxidation. The invention further consisted in the method of manufacture of the carbon conductor of high resistance so as to be suitable for giving light by incandescence, and in the manner of securing the same. And then he went on to describe what he must do, and when he came to the carbon filaments, he said they might be made in a variety of ways. When he came to his claims, did he claim any of those carbon filaments *per se*? He submitted that he did not. The first claim was for an electric lamp, consisting of a filament made as described and secured as set forth; the second, for the combination of a carbon filament in a reservoir, and so forth; third, the carbon filament arranged as set forth; fourth, the mode, not of manufacturing, but of securing the carbon filament. There was nothing which the patentee ought to have described that he had left out as regards the thing he claimed. But he had a further answer, which was that set forth in the Bovill *v.* Moore case.

Mr. JUSTICE BUTT: The objection is that after his provisional specification, 4,576, there is another provisional specification within six months, disclosing the fact that he knew of a good mode of making a carbon filament, and that he ought to have disclosed it as he knew it before his final specification. Your first answer is that he could not have included that without invalidating his patent. Are you right in saying that? There seem to me to be two or three passages in this provisional specification which would support the inclusion.

Mr. ASTON: Of course anything that is in the provisional specification may be amplified; there is no doubt about that. But I submit to your lordship that his invention began and ended when he said, use the best carbon filament you can get, put it in the best glass vessel you can get, have the best exhaust you can get.

Mr. JUSTICE BUTT: That is another point.

Mr. ASTON: That is for your lordship. If he had claimed the manufacture as a substantive thing, it might have been said that his provisional specification only directed a man to improvements in lamps as such. But I have a better answer. Bovill *v.* Moore was in 1816; there were no provisional specifications in those days. Mr. Aston then read the judgment in that case.

Mr. JUSTICE BUTT: A man patents an invention and he has in his mind's eye an improvement which would make it doubly available. He completes his specification of the inferior article and then, having done that, he goes on and completes the patent of the superior article. He may make a man pay license twice over. Has he a right to do so?

Mr. ASTON: Oh yes, my lord. That is a very different matter.

Mr. JUSTICE BUTT: Supposing his claims in 4,576 included the making of the filament which he describes in the subsequent patent, and then having omitted to state how he made it, took out a second patent to work his whole thing more efficiently, the public would have to pay for the two licenses.

Mr. ASTON: Yes, my lord; or double license for the first.

Mr. JUSTICE BUTT: Does the law allow that.

Mr. ASTON: Yes; there is no law against it.

Mr. JUSTICE BUTT: Does the law allow a man to do that and give to the public the thing piece-meal?

Mr. ASTON: Certainly, my lord. I know of no case against it. Do we not know over and over again that a man splits up his patent into two or three things?

Mr. JUSTICE BUTT: Do you mean to say that if he does it by inadvertence it does not operate against him, whereas if he did it knowingly it would?

Mr. ASTON: It would in both cases. I do not mean that. He has not communicated to the public the most beneficial mode he was possessed of for exercising the invention. Suppose as a rider to his specification he had issued a notice, "I tell all the world this is a good way of making the filament," would not that have satisfied the condition? Is it not the same thing whether he tells that by one document or by another document? I have never yet heard that he is bound to give the further information he may be possessed of in any particular document. This is on November 10th; his second patent is taken out on December 20th. Suppose that were not published; you have put in your complete specification that which is proved not to have been invented at the time of your provisional specification. Would not that have invalidated it?

Mr. JUSTICE BUTT: That is very good argument, if sound.

Mr. ASTON then proceeded to argue that the electric lamp, etc.,

made as described, etc., was in substance a lamp such as Mr. Rawson's. That the defendants' lamp was made by carbonising after the filament was formed was clear, because Mr. Rawson himself said, when he talked of the securing, that it was secured by depositing the carbon after the carbonisation of the filament. Upon the evidence he submitted his lordship might fairly be asked to find that the combination described by Edison was used.

The SOLICITOR-GENERAL, in answering upon the cases cited, said that as to every one of those cases, if his lordship would read the reports he would find that in every one there was a new machine or a new manufacture. It might be right or it might be wrong, but the whole stress of his argument had been, you have not a new manufacture. In Otto *v.* Linford it was contended that it was only a repetition of Johnson's combination, but the court held, rightly or wrongly, that it was a different combination, a different arrangement of the same constituents, and a different arrangement whereby the machine was made a different machine. Edison's lamp was only a particular form of Swan's combination. In the duplex lamp case, it was discovered that flat burners gave a totally different result from that obtained by means of the round burners. That was a new combination. Nobody could have said that the second lamp was the same as the first.

His lordship announced that he should be prepared to give his decision on the following morning.

Thursday, May 20th, 1886.

THE JUDGMENT.

Mr. JUSTICE BUTT: The plaintiffs in this action complain of the infringement of three patents relating to the construction of an electric incandescent lamp. The first of these patents is that of Mr. Edison, which I will describe later on. The principal feature, as I understand the matter, of Mr. Swan's patent is the process by which he proposed to make and maintain, or proposed to maintain a nearly perfect vacuum in the globe. Mr. Gimingham's patent is one for fixing the carbon burner of the incandescent lamp to the platinum wires. The defence consists of a denial of the validity of the patents and a denial of the infringement. As to Messrs. Swan and Gimingham's patents, I intimated at an early stage of the proceedings that there was no evidence of such infringement, and I do not understand that that view has been since seriously contested. The question, therefore, of the validity of those two patents becomes for present purposes immaterial: their validity is beyond the sphere of our present enquiry. Now, with reference to Mr. Edison's patent, which is a patent of May 10th, 1880, there is one fact which is either admitted or beyond contest in the case, and that is that before the date of the specification in question, no good and efficient incandescent lamp was made or known. The invention Mr. Edison claims has been compendiously stated by Sir Frederick Bramwell in his evidence, and he states it in these words: he is asked by Sir Richard Webster this question, "Of course the construction of the specification is entirely for my lord, but would you please tell us, only for the purpose of pointing to previous knowledge, what combination you find described there as an electric machine or lamp?—(A.) I find a vessel made entirely of glass containing a carbon filament attached to conducting wires, which wires are sealed through the glass. I find, for this vessel has to be exhausted of its air to a very great degree, the patentee mentioning that one-millionth of an atmosphere may be obtained. The patentee says that with a lamp of that construction light can be obtained by rendering the filament incandescent by means of an electric current." That is his account of the invention, and I adopt that account; and I adopt it without the slightest hesitation, because it is not a matter which depends upon my own judgment; it was accepted by all the scientific witnesses called by the defendants; it was accepted in terms by Dr. Frankland, and the other gentlemen who were called on the same side stated that they agreed with his evidence. Now, that is an invention for the infringement of which those of the plaintiffs who are owners of the legal and beneficial interest of this patent, No. 4,576 are now claiming an injunction and damages. As I have said, the defendants deny the validity of the patent; they also deny its infringement by them. I think it would be convenient to deal with the latter question first. I have all the way along been clearly of the opinion that there is no proof of the infringement of claims No. 3 and 4 in Mr. Edison's specification. Those claims are as follows:—"No. 3. A coil of carbon filament or strip arranged in such a manner that only a portion of the surface of such carbon conductor should radiate the light, as set forth. No. 4. The method herein described for securing the platinum conducting wires to the carbon filament and carbonising the whole in a closed chamber, substantially as set forth." I now think, whatever may have struck me at different parts of this enquiry, I now think that there is no infringement of claim No. 1, and I shall be prepared to hold, if necessary. Claim No. 1 is in these words: "An electric lamp for giving light by incandescence consists of a filament of carbon of high resistance, made as described, and secured to metallic wires as set forth." But in the view I take of claim No. 2 this question becomes unimportant. Now the question of the infringement of claim No. 2 depends on the meaning to be attached to the words in it, a carbon filament. If those words mean a carbon filament made as described in the patent, I should hold that there was no proof of its infringement; but I do not so interpret those words. I hold them to mean any carbon filament, however made, which possesses certain qualities or properties mentioned in the specification or necessarily resulting from the description there given. To answer that description the carbon filament must, I think, possess flexibility and resiliency, it must be of small cross-section, offering a high degree of resistance to the passage of the electric current, and it must present but a small surface from which radiation of light can take place. I am disposed also to think—but on this I refrain from giving a decided opinion—that the degree of resistance must not be less than 100 ohms, as mentioned on page 3 of the specification. Taking the above to be a correct interpretation of the words carbon filament in claim 2, it is clear that there has been an infringement of the patent by the defendants. Without reading the evidence of the plaintiffs' witnesses, it will suffice to read part of that given by Mr. Rawson, one of the defendants. Now, in the course of his evidence Mr. Rawson states as follows: "We have used carbon filaments connected at the ends with platinum wire in a vessel made wholly of glass practically. The leading wires passing into and from the receiver are sealed into the body of the glass vessel and the air is exhausted so as to get as good a vacuum as we can. We use that combination with the object of getting a good incandescent lamp, and in that incandescent lamp we use a carbon filament that is flexible and as stable at high temperature as we can get it. We do not use Edison's process for the purpose of making a filament. What we do is in substitution for this process. Our process of making and preparing carbon filaments is superior to Edison's." This is evidence, and, as I have said, taking that evidence, applying the interpretation I have put, rightly or wrongly, on the words carbon filament in claim 2, there is an infringement of the patent. But it is said, even so, assuming the infringement, the defendants are not liable in this action, because the patent is invalid, and I will deal as well as I am able with the contentions of the various arguments by which they maintain such to be the case. It is not always easy to separate in a matter such as this that which counsel has argued from that which some of their witnesses have said, and it may be in stating the objections I shall in one or two instances deal with the evidence of some of the witnesses rather than with the Solicitor-General's arguments. I am anxious, of course, not to put anything into his mouth which he did not express; at the same time there are one or two matters in which, I think, the witnesses have gone beyond what he has argued. Of course if he had given up the points expressly I should not refer to it. Now, the first reason, as I gather, in support of the invalidity of this patent is this: it is said, a carbon filament when taken to mean that which I have held it to mean, is a description too vague and indefinite, or to use the Solicitor-General's words, too large. That is an argument to which I cannot accede, for I see no reason why s carbon filament having the properties mentioned in Mr. Edison's patent, and which the patentee tells the public how to make, may not properly be the subject of a patent, although it is capable of being made by methods and of materials other than those set forth in the specification. This observation certainly does not lose any of its force when the filament in question is not the thing patented but only one of the several parts of a combination patent. Secondly, it is said—I am not professing to give the arguments in the order in which they were given—secondly, it is said, that the specification is not such as would enable the competent workman to make the lamp. The plaintiffs' witnesses have stated that in their opinion it would enable him to make the lamp. I use the word "the" lamp for the moment as apart from the question of a good lamp. Having had an expression of opinion from several of the plaintiffs' witnesses to that effect, I find that when Dr. Odling comes to be examined—cross-examined I think it is—on the subject, he says what I am going to read: "Mr. Edison first applied the word filament to the conductor of an incandescent lamp. Any competent electrician could make by the description in Edison's patent the carbonised filament there described. Geissler's vacuum tubes were perfectly well-known in England. They were wires sealed through the glass. Sealing through the glass was a perfectly well-known operation to electricians. A competent electrician would want no other directions as to sealing wires than Edison gives in his specification. A competent electrician would have no difficulty in properly exhausting the globe from Edison's specification." I take that as making very strongly in favour of what the plaintiffs' witnesses have said, and I hold, therefore, that the evidence does establish sufficient to place the converse proposition, that the evidence does establish that the specification in question is one which would enable the competent workman to make a good lamp. But then, in the next place, if I understand, it is said that a lamp made according to the specification would not be a good lamp. So say some certainly of the defendants' scientific witnesses; but there is evidence from the plaintiffs' witnesses to the contrary, and moreover the Solicitor-General expressly stated that he did not dispute the utility of Mr. Edison's invention. Under these circumstances in the conflict I come to the conclusion that a good lamp, a sufficiently good lamp for the purpose, may be made by a competent workman from the description given in Edison's specification. Fourthly, it is said, and at one time I was strongly inclined to go to the suggestion—it was said by the Solicitor-General that the patent was invalid, because at the time of the final specification Mr. Edison himself knew of a better method of making the filament. And in support of that proposition his provisional specification of December 15th, 1879, No. 5,127, was referred to. Now, the date of that provisional specification, it will be observed, is subsequent to the date of the provisional specification which we are now considering, which is of the 10th November preceding. But it was many months prior to the final specification we are considering, and

therefore it is perfectly true to say that at the time of the final specification Mr. Edison knew—I do not know whether I should say a better mode, but he knew at all events of another mode of manufacturing his carbon filament. The Solicitor-General said a better mode; perhaps he is warranted in that; I am not prepared to deny that. Therefore, the argument is, he ought to have disclosed it in his final specification because a patentee is not entitled, on the authorities, and as a matter of good sense he is not entitled, to withhold from the public matter of discovery of which he was aware, forming an important integral part of his provisional specification of his patent and then take out another patent afterwards for that. It was said so to do would be to put the public, or those at all events who deal in such matters, to the inconvenience and expense of taking out a license to use two patents, whereas they ought to have had the whole user of the patent by taking out a license for one. It must, however, be borne in mind that Mr. Edison does not claim in his patent 4,576 for the manufacture of the carbon filament. His claim is for the union of carbon filament possessing certain properties with the other parts of his combination. There is no evidence that at the time of filing his provisional specification 4,576 he had discovered or knew of the process in patent 5,127. And I agree with Mr. Aston that an inventor has no right to put into his final specification as part of his invention a discovery which he had not made at the time and of which he was ignorant when he filed his provisional specification. I think, therefore, the contention on this head cannot avail against the plaintiffs. But further it is alleged that the invention was not new. And this is the part of the case that has occupied the greater part of our time. It is perfectly true that a number of specifications and other publications anterior to Mr. Edison's patent have been adduced describing either the separate parts of Mr. Edison's combination or something very like them. Without losing sight of the others, I refer especially to those of Mr. Lane-Fox, Mr. Pulvermacher, M. Sidot, and Mr. Swan. But not one of those publications, unless it be Swan's, contains the combination described in Mr. Edison's patent No. 4,576. That I am right upon this I think is clear from the evidence generally, and there is a passage in Dr. Odling's evidence which to my mind strongly confirms what I say is the effect of the whole of the evidence, that, at all events, if we except Swan's, none of the other publications contain a combination of all the elements of Mr. Edison. I do not propose to go through all the publications in detail, but a good example of them, I think, may be found in the patent of Mr. Pulvermacher. It is said that that is a clear anticipation, at all events, of claim 3 in Mr. Edison's specification. Now, it is perfectly correct to say that we have in Pulvermacher's specification a description of a carbon rod or thread which, if taken by itself, is very like Mr. Edison's coiled carbon filament mentioned in claim 3, taken by itself. But it is used by Mr. Pulvermacher in a totally different way, and for a totally different purpose. That, as I understand Mr. Pulvermacher's specification, was to be applied, not to an incandescent lamp, but to an arc light. The spiral in question was to be coiled round an inner core, also of carbon, there being insulation between the two. It is not to be attached to wires at both ends, of course, that being inconsistent with the notion of the arc light. Curiously enough, too, Mr. Pulvermacher's patent deals with two modes of lighting, the arc light and the incandescent light, and it is very remarkable that, having described in detail this spiral rod or thread for the purpose of his arc light, when he comes to state what his mode of procuring an incandescent lamp is, he discards his carbon conductor altogether, and resorts to metallic wires. Whatever likeness there may be between Mr. Pulvermacher's spiral rod and Mr. Edison's coiled carbon filament mentioned in claim 3, it is perfectly clear to my mind that Mr. Pulvermacher was wholly unaware that a coiled thread of carbon could be applied to the purposes of incandescent lighting, because if he were aware of it he certainly would not discard it when he came to make his incandescent lamp, which is provided for in the very same patent. Dr. Odling said: "Lamp E. F. 3" (that is the lamp, I think, that Dr. Frankland had made under his inspection and produced) "could not be made from Pulvermacher's patent, nor from anything known prior to November, 1879, except Mr. Swan's description, which would have enabled a competent electrician to make one. (Q.) Whence could he—that is, the competent electrician—get directions which would enable him to make that filament?—(A.) I thought he could have got it from Pulvermacher's specification, but I find that is not so. (Q.) Anywhere else?—(A.) I do not call to mind that there is. For Pulvermacher's purposes the spiral must be of considerable size and thickness." So much for the alleged anticipation by Pulvermacher. With regard to Mr. Lane-Fox, I do not think it necessary to go at any length into the descriptions of his proposed lamps or systems of lighting. It seems to me that the Solicitor-General was perfectly warranted when he said it was abundantly clear from the different specifications of Mr. Lane-Fox that he had realised and knew all the elements that were necessary to make a good incandescent lamp. I will illustrate what I mean by one example—the necessity, for instance, of a high degree of resistance. I think those observations were perfectly warranted, and it is true that although, as I have followed them, when he comes to prescribe what he would use for the purposes of his own invention, Mr. Lane-Fox nearly always seems to revert to metallic wires as a conductor, and not the carbon, he does mention in one or more of his specifications a carbon conductor, but then, as I understand the matter, like Mr. Pulvermacher, when he comes practically and finally to deal with the matter he disclaims it, and it drops out of his patent, evidently because he did not know how to make an efficient carbon conductor. The carbon conductor he had described he must have thought, he says, in fact, it was less desirable than metal, under all circumstances, and he did not know how to make one which would be better. Passing over the other matters, I now come to the alleged anticipation by Mr. Swan. Now, it seems to me that his lamp is the only combination at all like Mr. Edison's. Other inventors, other men of science, might have described individual parts of the combination, but none of these has brought all those into combination like Mr. Edison has. The law I take to be clear. Each individual part of the combination might have been known before, yet if the combination of those parts be new, that combination may properly be the subject of a patent. But it does appear to me that if Mr. Swan's conductor was practically the same thing as Mr. Edison's carbon filament, then we have in Mr. Swan's lamp and in Mr. Swan's lectures, I think, the whole of Mr. Edison's combination, and that before the date of Mr. Edison's specification. The question therefore is—the main question to my mind—are Mr. Swan's carbon rod or pencil and Mr. Edison's carbon filament practically the same thing. Now, I think they are not. It is a question of interpretation, and *prima facie*, no doubt, the meaning of words in a written contract is for the judge. But where technical terms, words of art, are used, the evidence of scientific witnesses and experts in the matter to explain the sense in which they are used, in their opinion, may be received. Accordingly, each side has called a certain number of scientific witnesses to whom has been put the question of the meaning of the word a carbon filament in claim No. 2. Well, it is said that in the multitude of counsellors there is wisdom; but when those counsellors turn out to be equally divided in opinion and when it turns out that the only point on which they agree is that they agree to differ, I do not see how the judge derives very much benefit or advantage from their evidence. Such is the case here. The witnesses on behalf of the plaintiffs say Mr. Swan's was in fact—I do not say the very word, but substantially they say Mr. Swan's carbon rod or pencil is not only different from Mr. Edison's carbon filament mentioned in claim No. 2, but it is totally and wholly different. The defendants' witnesses say, in our opinion those two things are identically the same. Well, in these circumstances I must draw such conclusion on the point as my uninstructed mind may enable me to arrive at. To my mind it does seem that the carbon pencil or rod is a very different thing from the carbon filament. It is difficult to express exactly the whole process of reasoning by which I come to that conclusion. But it seems to me to carry one a long way on the road to that conclusion to say that a rod or pencil is a rod or pencil, and the thread is a thread. There are, however, certain differences which are not difficult to explain. It appears to me clear that one of those differences between Mr. Swan's conductor and Mr. Edison's conductor is this: Mr. Edison's conductor possesses a smallness of cross-section, combined with other properties, which Mr. Swan's does not; Mr. Edison's possesses a degree of flexibility which, to my mind, is not even approached by Mr. Swan's, and I think I am again confirmed in this view by some of the evidence given by Dr. Odling, one of the defendants' witnesses. In speaking of Swan's he says: "I cannot point to anything in the specifications in which any other than a rod or stick of carbon alone is described. In the lamp of Swan produced the conductor is a rod." Now, then, to show what he meant he says, in effect, true it is a rod, but it is a filament also, and I refer to Mr. Swan's subsequent communication in July, 1880, in which he calls his conductor a filament. But then you know, as a matter of anticipation that rather broke short in Dr. Odling's hands, because instead of its being an anticipation it is about a twelvemonth after the event. He goes on to say: "As applied to a conductor exclusively of carbon, I cannot point out any anticipation of Edison's statement contained in the passage from line 23 to line 43 on page 3 of the specification." The statement to which he referred begins with the words "Heretofore lighting by incandescence," and ends with the words "very high temperatures." Now, I cannot help thinking that if Mr. Swan at the time in question, not in June, 1880, but at an earlier period, before Mr. Edison's specification—had Mr. Swan known of the various advantages of Edison's carbon filament *as used*, his lamp would never have contained a straight rod fixed at each end, and by straight I mean, of course, lying evenly between the two points of junction, a straight rod so fixed in the ends of platinum wires. Moreover, I think there is no evidence to show that before Mr. Edison's specification he knew how to make a carbon conductor of anything like so small a cross-section which would answer the other requirements stated. The first time which I can find Mr. Swan's conductor spoken of by him as a filament is in his final specification of the patent which forms one of the matters of this suit, and that is under the date of July 1st, 1880, Mr. Edison's final specification being some seven or eight weeks prior to that. True it is that, having, if he chose to use it, of course—what he read and what he did not read is unknown to me, but having at all events, if he had chosen to use it, the advantage of the knowledge conveyed to the public by Mr. Edison's specification, we do find Mr. Swan some weeks later calling his carbon conductor a filament. Now, you know, a rose does not smell any sweeter for being called a rose, and the fact that Mr. Swan did subsequently call that rod a filament does not at all convince me that it was properly so called. I do not forget that it is also in evidence from one or two of the defendant's witnesses, from Dr. Odling, I think, amongst the number, that electricians have adopted the word filament,

and as I understood him applied it to all manner and kinds of carbon conductors in these incandescent lamps. Well, that may be so. Words often become, when applied to particular trades or sciences, twisted from their original meaning. A dozen at one time meant twelve, but I am not quite clear what it has not been held to be in particular trades. It certainly in many does not mean twelve, or anything like twelve. So with regard to these matters. An illustration was given by a portion of a very beautiful flower; I believe it was a tulip produced, and I was referred to that portion of it which holds and supports the anther as a filament, and I was told that in botany that was universally recognised as a filament, of whatever size it might be. That may be; it is clear that that portion in botany, just as these conductors have since amongst electricians, acquired the name of filament, but I suspect that it will be found that they have acquired the name of filaments since flexibility was introduced and rigidity tabooed. Well, on the whole, I have therefore come to the conclusion, firstly, that there is no sufficient reason for saying that this patent is invalid on any of the grounds suggested on the part of the defendants, amongst others, of course, that there is no ground for the assertion that it has been anticipated, or, in in other words, that it is not new. In the next place, I hold, attributing the meaning I have to claim No. 2, that there has been a clear infringement by the defendants in their lamp. That being so, the decree I must make is, that those of the plaintiffs who possess the legal and beneficial interest, I suppose who are the assignees of Mr. Edison's patent, are entitled to relief. With regard to the other plaintiffs, of course—the precise form I do not know—but they must be withdrawn or dismissed.

Mr. ASTON: Action dismissed with regard to them. In the usual course I have to make an application to your lordship that your lordship will be pleased to grant a certificate that the validity of the Edison patent came into question.

Mr. JUSTICE BUTT: Yes.

Mr. ASTON: Next, that an account of the profits made by the defendants by the sale of their articles which are in question be rendered.

Mr. JUSTICE BUTT: That, I suppose, is the regular course; that is included in the plea.

Mr. ASTON: Next, with regard to the lamps in the possession of the defendants. The certificate that the validity of the patent came into question should extend, that the charge as to the plaintiff is made out with regard to the infringement—that the plaintiff has proved the breaches. That is under the statutes. Then there is one other question with reference to the lamps possessed by the defendants. We do not wish to deal hardly at all with the defendants in this case. They have, no doubt, in stock a number of lamps that they would desire to sell. They may either hand them over to us or make such arrangements as they think fit. We shall be entitled, of course, to have them destroyed. We do not wish to deal harshly with them, and no doubt that matter can be arranged, but we are entitled, according to all precedent, to have either those lamps delivered up to us or that they be destroyed.

Mr. JUSTICE BUTT: I suppose I must make the order. I will hear what Mr. Charles has to say. It is, I presume, *prima facie*, a thing the patentee is entitled to ask. I do not, of course, want to make the decree any harsher or harder against the defendants than I am compelled to do.

Mr. ASTON: Then I ask that the costs be on the higher scale.

Mr. JUSTICE BUTT: I must hear what Mr. Charles says on that.

Mr. ASTON also asked for the costs of the shorthand notes.

Mr. JUSTICE BUTT said the shorthand notes had been very useful during the hearing.

Mr. MACRORY asked that the costs should be confined to the evidence.

Mr. ASTON: I quite agree.

Mr. JUSTICE BUTT: I am quite sure of one thing. I daresay this case will go further, and although my notes are what the Court of Appeal will go upon, I am quite sure the Court of Appeal would not care to go upon my notes alone.

Mr. CHARLES: I do not think we can object. If you think it is a case in which the costs ought to be on the higher scale, I will not press any objection. With reference to Swan and Gimingham, I ask your lordship to dismiss the action with costs.

Sir RICHARD WEBSTER: Such costs as have been occasioned by the claims of Swan and Gimingham.

Mr. JUSTICE BUTT: Just say such costs as have been occasioned.

Mr. CHARLES: I have respectfully to ask for a stay of execution.

Mr. JUSTICE BUTT: I don't know about these matters. If the infringement is proved——

Sir RICHARD WEBSTER: We are entitled to an injunction, of course?

Mr. JUSTICE BUTT: Anything I can properly do to forward the defendants on their way to the Court of Appeal I will do.

Mr. CHARLES said that the order made upon the motion for an interim injunction was that the manufacture might proceed, upon the defendants undertaking to keep an account of the lamps made and sold. He now asked his lordship to suspend the issue of the injunction, the defendants giving a similar undertaking.

Sir RICHARD WEBSTER: That has never been done. I may point out that your lordship could not do so without a precedent in the teeth of what the Court of Appeal has held. What Mr. Charles has referred to as the order that is always made on an application for an interim injunction, is where the plaintiff has not a sufficiently strong case for an interim injunction. The Court of Appeal has held that, after final judgment, the court cannot suspend its injunction without stultifying itself, the validity of the patent having been held good in a court of law. The Court of Appeal pointed out that where a judgment stands in favour of the validity of the patent it is a consequence of that judgment that you should issue an injunction. If the defendants go on making lamps they must do so by making terms. That puts them in no worse case. My friend has no precedent for it.

Mr. MACRORY: I think there is one case.

Mr. JUSTICE BUTT: Before you come to your individual case, is not the general rule not to stay an injunction after the final judgment? Supposing you are right, and there is one case: in the multitude of these things the fact that there is only one case in which it has been done suggests to my mind a rule to the contrary. I need not say that if you can arrange any terms which would obviate and delay the injunction I should be very glad.

Sir RICHARD WEBSTER: It would so seriously affect the rights of the plaintiff company quite independently of the particular judgment that I shall resist it with all the powers I can.

Mr. CHARLES did not think his lordship would be doing anything very wrong if he suspended the injunction.

Mr. JUSTICE BUTT: But I must be right.

Mr. CHARLES: Then I submit you would not be doing right not to suspend the injunction.

Mr. JUSTICE BUTT: I do not think so, for if I understand rightly the rule is not to suspend, and that being so, although I regret it, because I have given, of course, the best judgment I can according to my conclusion; it may be right or it may be wrong—I should be very sorry in the event of its turning out to be wrong, that the defendants should suffer more injury from it than is absolutely necessary—therefore, my inclination would be entirely, if it were not inconsistent with other considerations, to stay the injunction, but I do not think I can do so.

Mr. CHARLES: Then there is another point, as to what lamps the judgment applies to. I am told we make lamps of all sorts of resistance. I am informed (I was not present when judgment was given) that your lordship held that Claim 2 is for a filament of so many ohms resistance.

Mr. JUSTICE BUTT: My judgment was given from notes, but when I came to what I considered a critical matter I put it down in black and white for fear of an unruly member going beyond what was intended, and I have exactly what I said upon that point, and I can read it to you. I said shortly that to answer the description I had thought and held that the carbon filament must possess flexibility and resiliency, that it must be of small cross-section, offering a high degree of resistance to the passage of the electric current, and it must present but a small surface from which radiation of light could take place. Then on your point what I said was: "I am disposed to think, but on this I refrain from giving a decided opinion, that the degree of resistance must not be less than 100 ohms, as mentioned on page 3 of the specification." I did not feel certain about that, and carefully worded it in that way.

Sir RICHARD WEBSTER: May I point out that it would be for your lordship to limit your judgment by some such measure. You are describing filament, and I ask you to look at page 3 of the specification from which the words are taken. What Edison there says is: "Even a cotton thread properly carbonised . . . . . offers from one hundred to five hundred resistance." The resistance of the actual lamp in manufacture does not depend upon the known use of the filament, the filament would be the same, but they would cut a shorter length of it. We will say a length of three inches and say that is the resistance, and then cut a smaller length and say it was not an infringement.

Mr. JUSTICE BUTT: It was a point on which I saw some such difficulty as Mr. Charles suggests.

Mr. CHARLES: So that your judgment is, that it must be a filament of high resistance.

Mr. JUSTICE BUTT: I do not say that. That and other things. I am less acquainted with these matters than scientific witnesses called, but I have one advantage over them, I am not subject to cross-examination.

Mr. CHARLES: If your lordship would specify——

Mr. JUSTICE BUTT: If I had decided that was a necessary part of the description of claim 2 it might be that I ought to grant that application; but I have not so decided. The answer to my mind is sufficient that I have not decided, I expressly said I would not.

A Wrong Use of an Electric Light Pole.—A curious and costly accident occurred to the Ball Street lighting system in Jersey City, on July 16th. The authorities, according to the American papers, are not very particular in granting permits for the removal of buildings, and John Costigan undertook to move a house from Prior and First Streets to 193, Bay Street. On Erie Street the workmen in charge of the tackle took a hitch around a convenient electric light pole, which was pulled over, bringing down the wires and short-circuiting a dynamo, burning it out instantly. It was a circuit of over 40 lamps, and the accident was so near the station that there were no intervening lamps. The company will probably bring suit against the house mover.

NOTES.

Ancient and Modern.—A remarkable spectacle, says the *Athenæum*, is to be witnessed on the 28th of this month at Orange in the South of France. A drama in verse by a young Avignonnais, M. Alexis Mouzin, entitled "L'Empereur d'Arles" is to be represented for the first time in the ruins of the ancient Roman theatre, which will be illuminated with the electric light.

Electric Lighting on the Glasgow Underground Railway.—For some time past there has been a good deal of grumbling among the passengers on this line owing to the carriages not being lighted in passing through the tunnels. Several schemes for lighting the carriages by gas and electricity were submitted to the North British Railway Company, and on Monday week the directors and Mr. Walker, general manager, made a trial of a carriage lighted by the electric light in the tunnel between Queen Street and College Stations. There is a 16 candle-power incandescent lamp in each compartment, and by the system tried the lamps light themselves on entering the tunnel, and go out on leaving it. It is proposed to use the electric light in the tunnel and during the day time only, and for this purpose the ordinary gas or oil fittings have not been interfered with, so that they can be used at night. We understand the company intend lighting the trains between College and Charing Cross Stations in the meantime, which should be of great benefit to the public, as at present the carriages are dark when standing at some of the stations. At the trial the lighting was very successful, both when the train was running at full speed and also when standing in the tunnel, while the light was quite as good as gas, and the cost, we believe, is considerably less. The carriage was fitted up at the Cowlairs Works, and the trial carried out by the railway company themselves. Mr. H. S. G. Carswell, one of their assistant engineers, is the patentee.

Electric Lighting versus Gas.—The *Gas World*, criticising the papers presented to the Electric Lighting Act Commission by Major Armstrong (which papers are summarised in another part of this issue), says:—"A variety of papers were submitted to the members of the Commission appointed to hear evidence regarding the Electric Lighting Act of 1882, none of which, perhaps, is more extraordinary than that handed in by Major Armstrong regarding the relative cost of cannel coal gas and electricity in lighting up certain rooms in the House of Commons. The Commissioners will be able to dissect this document and to discover its weak points. Major Armstrong, we have no doubt, has endeavoured to give a fair statement of the relative cost of the two illuminants, but that he has failed is apparent from a glance at the figures presented in his paper. The cost of maintaining the electric light during two sessions of Parliament, or 56 weeks, was £824, which, per hour, amounts to ·291d. per lamp. The estimated cost of gas for the same period was £740, or a difference in favour of gas of £84. But it will be observed that no mention is made in the report of interest upon the electric lighting plant, the total cost of which is stated at £3,340. Now, if we assume £200 as a reasonable sum in name of interest during the period that the lamps were burning, we think we put the amount within rather than over the mark, and if we add 5 per cent. for depreciation it will be seen that a material alteration must be made upon the figures unfavourable to electric lighting. By a very one-sided process of reasoning, however, Major Armstrong calculates the cost for the two illuminants per year, and he brings up the gas bill to £557 and reduces the electric lighting bill to £359. The three items he takes into account on the electric side are—cost of coal, £112; cost of lamps, £60; and wages, which he says are very high, £187. We say not a word concerning the other items which must be considered in any just comparison, but we think the Major ought to have extended the same fair play to gas that he has given to electricity. He ought to have instituted his comparison by using the very best of modern lamps for burning gas, and, had he done so, the figures he has brought out in favour of the electric light would have been very much the other way."

Electric Lighting in New England.—The Worcester Electric Light Company is said to be one of the most prosperous enterprises of the kind in New England. On July 1st it had 239 arc lights in actual use, and it was intended that before August 1st the lighting capacity of the plant should be increased to 279 arc lights, 112 of these to be for street lighting. The company has 10 Thomson-Houston dynamos, each capable of running 30 2,000-C.P. arc lights, and the motive power consists of five Armington and Sims engines and one Putnam engine. The boilers used are four in number, and are from the works of William Allen and Sons. Some months ago an iron structure for suspending an arc lamp over the middle of the street was made for the company. After a long trial it was acknowledged to be an indispensable and invaluable adjunct to any system of electric street lighting, and the company ordered 10 more.

Thomson-Houston Lights in Bangor.—The Thomson-Houston plant at Bangor, Me., is to be enlarged by the addition of a 45 arc light machine and a 300 incandescent machine. The new 100 H.P. boiler will be by the Penobscot River Boiler Company, of Bangor, and the Armington and Sims Company will put in the new 50 H.P. engine. The boiler will be set with the Jarvis furnace. Mr. Fred S. Palmer, the superintendent, hoped to have 150 incandescent lamps running by August 15th.

Light in New Jersey.—The various electric light systems are pretty well represented in New Jersey. The Brush, Weston, Schuyler, Edison, Westinghouse, Ball, Thomson-Houston, and probably various others, have plants in various parts of the State. Now the Fort Wayne Jenney Company has taken a contract to light Orange for an annual sum of $11,000. There were several competitors in the field.

Underground Electric Light Wires.—The Philadelphia correspondent of the *Electrical World*, says:—"The new electric lights on North Broad Street, from Columbia Avenue to Susquehanna Avenue, have now been in operation for nearly a month past, and their cheapness is calling attention to the fact that electricity can undoubtedly hold its own against gas, and give better light for less money. Councils originally made an appropriation of $2,000, at the request of Superintendent Walker, to make a test of underground electric light wires. It was decided to erect a lamp at each street corner, but, after the work had been begun, three citizens, living in the middle of the squares between Susquehanna Avenue and Berks Street, submitted a proposition to Mr. Walker that, if the city would erect the poles in the middle of the block, they would pay for the lighting. This was accepted, and there are now ten lights between the streets named. These afford a brilliant illumination, and the fact that private citizens are willing to pay for electric lights to light the public streets speaks well for the popularity of electricity. Then, as to the cost: When bids were asked for lighting this thoroughfare, the lowest price named was 75 cents per night, while the cost now is 50 cents. At this rate the cost of the plant will be met in three years. Another illustration of the superiority of the electric light over even the most modern improved gas light, has been afforded lately by a discussion over the location of some improved gas lamps at Dock Street Market, and it seems clear that electric lamps are very much cheaper than Siemens gas lamps. According to the figures given, eight Siemens lamps burning 50 feet of gas per hour would cost for a night of 10 hours at $1.70 per 1,000 cubic feet, $6.80 per

night. Four electric lamps, it is estimated, would give equivalent illumination at a cost of $2.20 per night. If as many electric lights as gas lamps were to be used, there would still be a saving by the use of electricity of $2.40 per night, or 30 cents per lamp. On the other hand, the Siemens-Lungren Company claims that its lamps give an illumination photometrically equal to that of an arc lamp, and that they burn 32 feet and not 50 feet each per hour. Even this showing places the rival lights only on an equal footing—that is, admitting that the gas light is equal in illuminating power to the electric light. The calculation can be easily made: a Siemens lamp burning for 10 hours 32 feet of gas per hour (the Siemens' own estimate), with the price of gas $1.70 per 1,000 feet, and an electric lamp burning at a stipulated price of 55 cents per night; the advantage is decidedly with the electric light, as the brilliant appearance of Chestnut, Broad and other Philadelphia streets bears evidence nightly. While speaking of this subterranean system of electric lighting on Broad Street, I ought to say that, besides the electric light wires, there are buried in this conduit other wires, making a total of eight miles of wire in the underground box. These will be eventually used for other purposes by the electrical department. The experiment of one month has been so satisfactory that a committee of City Councils has decided in favour of extending the underground electric light wires on North Broad Street, from the Reading Railroad to Lehigh Avenue, and thence to the Twenty-second District Police Station, at Lehigh and Park Avenues; also in favour of locating an electric light at Broad Street and Lehigh Avenue."

Electric Lighting in the Northern Counties.—Mr. H. Bury, of Manchester, has received instructions for carrying out installations of the electric light in the following places: Messrs. Dickins and Company's dye houses, at Middleton; Messrs. Walker and Carver's paper works, Pendleton; Messrs. Wm. Thompson and Sons' weaving shed and spinning rooms, Burnley; Messrs. J. King & Sons' weaving shed and spinning rooms, Rochdale; and Messrs. Rylands and Sons' mills at Swinton, for which last-named installation 1,100 lights will be required.

"Electric Lighting as an Investment."—Under this heading the *Scientific American*, of June 26th, contained the following:—"With a view to put at rest the question whether local electric lighting companies are profitable investments, we have recently addressed a circular letter to the general managers of a number of such companies, both East and West, asking for their experience in the matter. We have directed our inquiry in this instance particularly to those operating the Thomson-Houston system. We have received answers from all parts of the country, and the general tenor of the replies is that many of their local companies are earning better dividends than are yielded by the majority of other new enterprises. The question of profit rests first with the locality, and then, if this be judiciously chosen, with the system employed and the ability displayed in the management. Of those who have stated the exact profits of their investment, we believe the highest returns came from Omaha, Nebraska, where a company, operating four 30-light dynamos, had earned at the end of the first three months after incorporation 4½ per cent. on the investment, or at the rate of 18 per cent. per annum. Two more dynamos of the same capacity have since been added to their plant. The gentlemen connected with this company are so well pleased with these results that they procured a franchise for operating in Des Moines, Iowa. They began by running 65 arc lamps, but have since increased their plant. Replies have also been received from Washington, St. Louis, Worcester, Terre Haute, Auburn, Me., Salem, Mass., Quincy, Ill., Kansas City, &c., which confirm these results, and state emphatically the belief of the writers in the desirability of electric lighting as an investment. These conclusions, although derived from the working of the particular lighting system we have named, may be equally valid and reliable for other systems now before the public, although we are advised that a greater number of local companies are operating their system than any other, and we find these companies uniformly successful so far as our inquiries have extended. There is room for great extensions of these local lighting companies in all parts of this and foreign countries."

Stephen's Individual Telephone Call.—We have been requested to explain that in actual practice the pendulum of this apparatus (See ELECTRICAL REVIEW, July 30th, page 115) consists of a pivotted coil of wire moving in a magnetic field and not of an armature moving opposite an electro-magnet (as was shown for the sake of simplicity of explanation in the descriptive article). This arrangement is found by the inventor to be far more satisfactory in its action than the electro-magnet and armature and is one distinctive feature of the apparatus. Another point to which attention requires to be called is the construction of the "relay," which actuates the lever carrying the disc and which also works the switch. This in actual practice consists of a straight electro-magnet whose ends play between two fixed permanent horseshoe magnets; the electro-magnet is fixed at right angles to and at the end of the lever referred to, and is parallel to the axis of the lever; it moves of course with the latter. This arrangement is found to act very satisfactorily, and adds materially to the certainty of the action of the apparatus.

Lancashire and Cheshire Telephonic Exchange Company.—The trunk wire system is undergoing rapid extension and development in the North of England, as the bulky little volume which we have just received from the Lancashire and Cheshire Company testifies. The amalgamation for trunk wire purposes of the Lancashire and Cheshire and National Telephone Companies has widely extended the sphere of usefulness of each company, such distant places as Sheffield and Lancaster, Leeds and Blackpool, Bradford and Liverpool, being now in communication.

The Telephone in Sweden.—During the last few years the telephone has become greatly used in Sweden. At the end of last year the state lines were 1,200 miles in length, with 1,255 apparatus. There were 15 central telephone offices and 46 telegraph offices. The receipts for the year were £5,500, leaving a net profit of £2,000. In the city of Stockholm, with 200,000 inhabitants, there are no less than 5,000 apparatus in use, which last year transmitted 5,000,000 of messages. The length of the wires of the private companies is 800 miles, the subscription being about £7 a year. In 1884 the number of subscribers was only some 2,500. Lately, attempts at long-distance telephoning have been made with great success, several places fifty miles distant being now connected with the capital. The telephone is now extensively used in nearly every town.

The United Telephone Company.—There is no doubt whatever, the *Financial News* thinks, that the United Telephone Company could do a great deal more business than it does now if there were a little more enterprise in the management. Where it has 4,000 subscribers in the City it should have 50,000. But how are these 46,000 to be got? We suggest that they could be best obtained by systematic and judicious advertising and canvassing. We know by our own experience that there are many people who are at present ignorant of the facilities that the telephone affords and of the price at which they can be enjoyed. The company, in the old-fashioned eighteen-hundred-and-fast-asleep style, is hiding its light under a bushel. Let it bestir itself, and not be above asking for business. In these go-ahead times advertising is the very backbone of business; and why should the United Telephone Company not publish to the world the merits of its wares, and benefit accordingly.

Telegraphic Communication between Liverpool and Havre.—One of the last acts of Lord Wolverton before vacating the office of Postmaster-General, was an important step towards improving the telegraphic facilities between Liverpool and Havre. The commercial and other relations between Liverpool and the leading continental ports and inland cities are so continuous and extensive that for a long time past serious inconvenience has arisen through the inadequate means of communication by telegraph. At last, in January of this year the Liverpool Chamber of Commerce made a strong appeal to the Post Office to establish direct wires from Liverpool to Havre, Paris, Berlin, Frankfort, Hamburg, Vienna, and other principal places in Europe. No definite promise was, or could be then given, except to consider the matter. This undertaking was, however, given and thoroughly fulfilled, with the result that Lord Wolverton informed the Chamber of Commerce that, with the co-operation of the Submarine Telegraph Company, he had obtained statistics as to the number of messages passing between Liverpool and the places mentioned above. He had arrived at the conclusion that the business was not sufficient to justify the provision of direct wires to these towns except Havre. Between Liverpool and Havre, however, the department were of opinion that there should if possible be a direct wire, and they had not ceased to make efforts to attain that end. Lord Wolverton added that he had given instructions for those efforts to be continued, and expressed the hope that they would be successful.

Telegraphic Communication with Light Ships.—On Friday last a deputation from Ramsgate, accompanied by Colonel King-Harman, M.P., and Sir Edward Birkbeck, M.P., waited upon Lord Stanley at the offices of the Board of Trade to urge upon the Government the necessity of adopting telegraphic or telephonic communication with the Goodwin Sands and elsewhere with a view to the saving of time in communicating with vessels in distress, considerable delay being sometimes occasioned by signals failing to reach land, and thus minimising the chance of timely succour.—Colonel King-Harman, M.P., having introduced the deputation, Sir Edward Birkbeck, president of the National Life-boat Institution, gave many instances in which, if the lightships had been able to communicate with the land, much loss of life and property would have been prevented.—Several gentlemen having spoken, and pointed out the practicability of attaching, at a comparatively small cost, a wire to the cable about to be renewed to Ostend, Lord Stanley, in reply, said he deeply sympathised with the objects of the deputation. He would make all the inquiry he could into the subject, and if the matter could be dealt with without conflicting with other interests, it would have his careful attention.

The Champion Telegraphist of the World.—"Mr. John Pender, who is at present on a visit to Denmark, was on Friday last entertained at a large banquet by Mr. Tietgen and the directors of the Great Northern Telegraph Company. Many distinguished citizens were present, including the Minister of Marine and Sir Edmund Monson, the British Minister. In concluding an able and cordial speech Mr. Tietgen, in alluding to the fact that to England and Denmark was mainly due the credit of carrying out the great submarine telegraph system which now brings the civilised world into daily communication, and to the part borne by Mr. Pender in its initiation and development, paid him the graceful compliment of offering him the telegraphic championship of the world. In replying, Mr. Pender emphasised the great and growing importance of the system which was now playing such an important part both in political action and commercial development, and stated that those entrusted with the direction of submarine telegraphs were unanimous in their desire to provide all possible facilities and thus extend and increase its usefulness and value to the world at large." We cut the foregoing from the *Daily News* of Tuesday last. The paragraph needs small comment from us as our readers are well aware that the honourable ex-M.P. beats the record. With marked originality and dogged perseverance the "Champion Telegraphist" has made many a slip to the admiration of all beholders.

A South African Telegraph Manager.—The Buenos Ayres *Standard* of a recent date contained the following interesting announcement:—"Mr. Allen, general superintendent and manager of telegraphs on the Buenos Ayres Great Southern Railway, has retired, after a constant, active, and honourable service of nearly 20 years. He leaves for Europe by the R.M.S. *Neva* with the esteem and good wishes of all who knew him. Mr. Allen came to the Plate, we may say, in the infancy of telegraphy, and when the only telegraph line existing in the country was that of the Buenos Ayres and Montevideo, so ably managed by Chevalier Oldham. The magnificent telegraph system not only of the Buenos Ayres Great Southern Railway, but also that of the Northern Railway of Buenos Ayres and the Ensenada Railway and Campana Railway were organised and established by Mr. Allen, and, indeed, we may remind our Postmaster-General that Mr. Allen also lent valued services to the Argentine Government telegraph department, and aided in its creation. Mr. Allen's retirement from so important a post will long be felt, not only by his friends and employés on the Great Southern Railway, but also by the wide circle of the British community in the Plate in which he moved, and was so deservedly esteemed." Mr. Allen was the local hon. sec. and treasurer of the Society of Telegraph-Engineers and Electricians, in which offices he is succeeded by Mr. John Oldham.

The Telegraph in Burmah.—Telegraphic communication had on the 19th inst. been interrupted for some days at Mandalay.

Indian Telegraphs.—A line of military telegraph from Lukhmpur, on the border of British India to Manipur, and even further east, will probably be erected during the coming cold weather.

West African Cables.—We are informed that the Silvertown Telegraph Company has received advices from West Africa announcing the completion of the Accra-Porto Novo section and the Porto Novo-St. Thomé section for the West African Telegraph Company on the 6th and 10th inst. respectively. These stations, as well as the grand Bassam station already connected to Accra, will be open for public traffic on the completion of the Sierra Leone-Accra section of the African Direct Telegraph Company which it is expected may be laid from day to day.

The Telegraph Construction and Maintenance Company, of Greenwich, completed the Sierra Leone-Accra cable for the African Direct Telegraph Company on Monday the 23rd inst. This line will shortly be opened to the public service. It is expected that by the end of September all the principal ports of West Africa, including the Gulf of Guinea, will be in telegraphic communication with Europe.

Halifax-Bermuda Cable.—The British Government has advertised for tenders for a cable to connect the naval station of Bermuda with Halifax, Nova Scotia. It is expected that this cable will be laid next summer. The determination on the part of the Government would seem to show that the necessity, from an imperial point of view, of connecting up telegraphically important strategical points is receiving the attention this subject deserves.

New Irish Sea Cable.—The postal telegraph cable ship *Monarch* has left her moorings at Woolwich, having on board the new 4-wire cable, which is to be laid across the Irish Channel from the Welsh to the Irish coast. The overhead line between London and the Welsh coast in connection with the new cable is in course of construction; this line is being wired with copper conductors.

High Insulation.—The insulation resistance of the Blackpool electric tramway conductor was, during construction, 4,490 ohms per 150 yards run. This amounts to something under 400 ohms per mile, but, says the projector of the Blackpool system, it has been practically impossible to measure the insulation of the finished line. We learn, however, that when the current is off the condensation and moisture upon the insulators make the resistance very small. This after a night of heavy rain or sea flood causes a serious loss. When commencing work in the morning sometimes as much as 100 ampères are absorbed; but after running the engines for half-an-hour the leakage will fall to 30 ampères. The average working loss with a difference of potential of 220 volts is between seven and eight horse-power. Like human beings this line appears to be fearfully and wonderfully made.

Mr. Smith, however, is not by any means consistent. In January last, at a meeting of the Society of Arts, he said, in allusion to the Blackpool line :—"Although they had been working through wet, wind, and snow, and the whole line had been deluged with sea water, they had been able to work with a loss of not more than one ampère of current." Who can say whether the whole current will not have disappeared by December?

The "Heat Cell."—Regarding the life of the cells described in the article on the conversion of heat energy into electrical energy on another page, Dr. Benjamin has informed the *Electrical World* that he has had one of them in his office from February, 1885, up to a very recent date, for a period of 15 months, during which time he caused it to yield its current and regenerate scores of times; and at the end, when it was broken up for examination, no difference in its internal constitution could be detected.

Engines for Electric Lighting.—Messrs. Browett, Lindley & Co., of Manchester, have recently delivered to the order of Messrs. Thompson and Ritchie, of St. Swithins, two pairs of vertical compound engines for the electric lighting of Winchester House, Old Broad Street, where 1,200 lights will be required, and they have also in hand, for the same firm, two pairs of engines for lighting the Northumberland Avenue Hotel (1,000 lights). Their works have for some time been very busily employed with this class of work, which has become a very successful speciality with them.

To a Correspondent.—If "Volt" will send us his name and address (not for publication but for our own satisfaction) we shall be pleased to insert his communication respecting the calibration of voltmeters.

The Whitecross Wire and Iron Company, Limited.—Referring to the *Gazette* notice of the voluntary liquidation of the above-named company, we are informed that the business has been sold to a new company, "The Whitecross Company, Limited," with extended objects and increased capital. None of the shares of the new company have been placed on the market, the shareholders in the old company having found the whole of the necessary capital among themselves.

The German Edison Company.—This company has opened show rooms in Berlin in which to demonstrate all the applications of electricity. The company has sent us three plates of drawings representing some of the apparatus employed, but we cannot say much for the artistic merit with which these illustrations are supposed to be invested. We hear exceedingly good reports of this company's transactions from a friend who knows.

Miners' Lamps.—Mr. Ellis Lever, writing to the *Morning Post* respecting the terrible explosion at Woodend Colliery, Leigh, on Friday last, by which 38 miners were hurried into eternity, denounced the Davy and other inferior lamps still allowed to be used in our coal mines, and stated that his conviction that a portable electric light burning *in vacuo*, may be constructed which shall fulfill all the necessary conditions, has induced him to renew his offer of a premium for the invention of a safe lamp.

The Lalande Primary Battery.—Speaking of the recent reports upon this primary battery, the *Gas World* says :—"Altogether, we are forced to admit that ingenuity is displayed in taking advantage of chemical reactions, but we gravely question whether in practical working and upon an extensive scale the figures given by Dr. Squire will be realised. If the Lalande battery is to be a success it must be widely adopted, and if it were so adopted then it is natural to expect that the price of zinc, copper, and caustic potash will rise; while, on the other hand, the increased production of by-products must speedily reduce their value. We have heard the statement made over and over again, that on account of the value of bye-products in the manufacture of gas tha illuminant could be given away for nothing. Neither gas engineers nor gas companies are responsible for such a wild statement. Its absurdity is too apparent to require comment. In this case, however, we have the gentlemen consulted by the promoters of the battery asserting that the bye-products of the charge are worth more than the original cost of material, and that the current is got for nothing. We doubt the soundness of this conclusion. We see innumerable difficulties to the working of the scheme, practical and chemical—we don't mean experimentally, but upon a large scale. Should these be overcome the Lalande battery will undoubtedly be a decided success; but until an extensive system has been introduced, and until the chemist has demonstrated the possibility of recovering the valuable product of sulphide of zinc white in large quantities and in a marketable form, we prefer to remain incredulous. The fact, however, that zinc, copper, and a solution of caustic potash give good results experimentally, without evolving dangerous gases, points in the direction in which chemists are driving to obtain a cheap substitute for present systems of artificial lighting."

A New Proof of the Wheatstone Bridge.—With reference to the communication which we have received on this subject, and which we print on page 208 of the present issue, we would remark that the author has merely given an incomplete exposition of the well-known geometrical proof of the principle of the bridge. We fail to see any points of novelty in the article.

Electrical Tramcar Efficiency.—It is estimated that the actual efficiency of the Blackpool tram line is about 45 per cent. In other words, the loss between engine power and the available motive power is 55 per cent. From the results of Marcel Deprez's experiments, and from the construction and working of the Blackpool line generally we imagine that the loss is considerably in excess of the above figure.

Primary Batteries.—The report of Professor Fleming on the Regent battery, which we publish on page 212, must be very gratifying to the proprietors. We are pleased to chronicle such an advance in double fluid cells, and shall be glad to learn that the Regent primary battery is making good headway.

Electrical Dental Appliances.—At the annual meeting of the British Dental Association held last week at the Royal School of Mines, the Electric Appliances Company exhibited in the Museum a number of electric appliances for dental observations. We are informed that the company's Victoria light battery again met with approval, and that this battery is being largely used by the medical profession in connection with examinations of the eye, throat, nose, vagina, &c.

The Phelps Telephone.—In the description of this receiver taken from an American Exchange it is stated that the diaphragm is not necessarily capable of induction. If the inventor of this apparatus thinks that he avoids Bell's claims he is much mistaken. The attachment of the steel or iron core to the diaphragm makes it equivalent to that of Bell.

Tramcar Driving.—There is a well-known conundrum of Lord Dundreary fame which is thus stated :—Q. Why doth a dog waggle his tail ? A. Because the dog is stronger than his tail ; if it wasn't the tail would waggle the dog ! Mr. Holroyd Smith has evidently taken this to heart for he says :—"The wheels have to drive the car, not the car to take the wheels ; but as the car is heavier than the wheels, it is better therefore that the driving power should come from the car."

A New Lecture Lantern.—Professor A. Gray and Mr. T. Gray have devised a new electric lantern for lecture purposes. It consists essentially of a small Gramme motor combined with an arc lamp in such a way that the revolution of the motor moves the carbons in opposite directions, and keeps the arc sensibly constant in position. The lamp itself has several advantages, for example, the addition of condenser lenses. The distance of the lenses from the arc can also be changed. The magnification can be readily adjusted to suit the distance and size of the screen, or, on the other hand, a parallel beam may be obtained for spectrum illustration. Moreover, the image of the arc itself can be projected on the screen, to show the mode of wearing of the carbons, the effect of placing impurities in the arc, or the attraction and repulsion of currents and magnets on the arc.

Personal.—Mr. Goode, whose name was prominent a few months ago in connection with the U. S. suit against the American Bell Telephone Company, has been ejected from his office of Solicitor-General ; the *Washington Post* says this is the result of a "shameful conspiracy," in which the American Bell Company has borne a part.

Dr. Norvin Green, president of the Western Union Telegraph Company, has accepted the vice-presidency of the American Exhibition to be held in London next year.

Mr. Ernest Danvers has resigned his position as Inspector-General of Colombian Telegraphs, and has removed to Caracas, Venezuela.

Mr. Edison, it is said, is "simply trying to cheapen electric lamps and the carbons," and is also studying earth currents and their availability for telegraphic purposes. He proposes to build a new laboratory for himself at Llewellyn Park next year.

Mr. F. D'A. Goold, of Manchester, after a five years' absence, returns to Egypt this week for the purpose of introducing the electric light into that country, where, we are informed, there is a large field for it. Amongst other business he will represent the Thomson-Houston International Electric Light Company of Boston, U.S.A., in that part of the world.

Gas and Electricity in Paris.—It is reckoned that there are now in Paris 16,044 incandescent lamps, and 2,225 arc or Jablochkoff lights. The *Bulletin Internationale de L'Electricité* gives an interesting analysis of the effect of this large number of lights on the Parisian Gas Company. Admitting that each incandescent lamp replaces one jet of gas, and that each arc light is equivalent to 10 ordinary burners, an estimate which our contemporary considers very moderate, and one which gas manufacturers themselves cannot regard as exaggerated—this would represent in round numbers 38,300 gas burners lost to the Paris Gas Company. At the rate of 140 litres of gas per hour these burners would consume 5,362 cubic metres, taking them to be lighted on an average for four hours a day during the whole of the 365 days of the year. This would amount to 7,755,520 cubic metres, which at the rate of 0·30 centimes per cubic metre, would put into the coffers of the company 2,326,656 francs. This sum is very considerable, but there has to be added to it what would be obtained from the sale of residual productions in the manufacture of this great quantity of gas if the electric light did not exist. In the face of such facts it is not surprising that the progress of the new illuminant is attracting in an unusual degree the attention of persons interested in the Parisian Gas Company.

Railway Intercommunication.—On the afternoon of July 15th a successful exhibition of a new automatic electric signal was given on the Fitchburg Railroad, U.S.A. Two cars equipped with the signal and carrying a party of railroad and newspaper men made a short run out on the Watertown Branch, states the New York *Electrical World*, where the workings of this new signalling apparatus were seen to good advantage. The device, which is automatic in construction and operation, enables trains to dispense entirely with the bell cord. The conductor can signal the engineer by means with which each car of the train is provided, and which do not require to be provided with separate couplings between adjacent cars. This is accomplished by utilising the couplings of the various automatic air brakes and their connections, so that no additional labour is required to make electrical connection throughout the train, as the circuit is instantaneously and automatically completed by coupling the air brakes together. The electrical current is produced by six Leclanché batteries, which are hermetically sealed and placed in a suitable box, which is carried on the train, thence connected with the bell in the cab. This device has been examined by a large number of the leading railroad managers of New England, who are said to have pronounced it practical and of great value, and prophesy its universal adoption.

Incandescent Lamp Patents.—At the meeting convened by Messrs. Shippey Brothers, and held at the Cannon Street Hotel on Thursday, a committee consisting of Gen. Alexander, Messrs. J. Fyfe, Joel, Lovering, Lefevre, Tongue, and A. Shippey, was appointed to investigate the facts respecting anticipations of Edison's patent for incandescent lamps, which were laid before the meeting by Mr. Arthur Shippey, and to report at a future meeting their opinion of the prospects of raising funds for "the frustration of the threatened monopoly."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

John Fowler and Company (Leeds), Limited (Hydraulic, telegraphic, electrical, and general engineers).—An agreement, dated 17th inst. and filed on the 18th inst., provides for the allotment of the following shares, as consideration for the business taken over by the company, viz. : to Mr. Robert Fowler, 10,000 preference and 9,187 ordinary shares ; Mr. David Greig, 3,800 preference and 3,000 ordinary shares ; Mr. R. W. Eddison, 1,900 preference and 3,000 ordinary shares ; Mr. Reginald Wigram, 6,300 preference and 2,813 ordinary shares. The preference shares will be considered as fully paid up, and the ordinary shares will be considered as paid up to the extent of £5 per share. The registered office of the company is at 6, Lombard Street, E.C.

River Plate Telephone and Electric Light Company, Limited.—An agreement dated 17th inst., and filed on the 20th inst., provides for the allotment of 50 fully paid £5 preferred shares in this company, Nos. 6,127 to 6,176, to Mr. E. F. Powers, in pursuance of an agreement dated 26th January, which stipulates that the company shall allot to Mr. Powers 50 fully paid preferred shares at the expiration of each six months from the date of such agreement, during such time as it shall

be in force, as further remuneration for his services as managing director.

Electro Metal Extracting, Refining, and Plating Company, Limited.—The registered office of this company is at 76, Finsbury Pavement, E.C.

Hirsch, Greystock and Company, Limited (Portable Electric Light Manufacturers).—The statutory return of this company, made up to the 29th June, was filed on the 6th ult. The nominal capital is £50,000 in £10 shares. 1,007 shares are taken up. 1,000 shares are considered as fully paid, and upon the remaining seven shares no amount has yet been called up.

At an extraordinary general meeting of the company, held at the office of Mr. Paul Alfred Boulton, 39A, King William Street, on the 21st ult., it was proved to the satisfaction of the meeting that the company cannot, by reason of its liabilities, continue its business, and it was resolved to wind up voluntarily, Mr. P. A. Boulton being appointed liquidator. The resolution was filed on the 3rd inst.

Edison and Swan United Electric Light Company, Limited.—The annual return of this company, made up to the 10th inst., was filed on the 17th inst. The nominal capital is £1,000,000 in £5 shares; 17,139 shares are fully paid, £3 per share has been called and paid on 89,261 ordinary shares, and there are 23,564 B fully paid shares; the paid up capital thus amounting to £471,298, being £117,810 in excess of the amount recorded in last year's return.

Daniel Judson and Sons, Limited. — The first return of this company is made up to the 22nd February. The nominal capital is £100,000 in £5 shares; the whole of the shares have been taken up. Upon 13,334 shares £1 10s. per share has been called and paid, and 6,666 shares are considered as fully paid, the paid up capital thus amounting to £53,000. Registered office, 77, Southwark Street.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the weeks ending August 13th and August 20th were £2,532 and £1,913, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1886.

10619. "Short-circuiting devices for magneto generators." G. A. MASON. Dated August 19.

10620. "Automatically administrating an electric current." W. S. OLIVER. Dated August 19.

10630. "Electric fire alarms." R. M. SOMERS. Dated August 19. (*Complete.*)

10644. "Electrodes for secondary batteries." A. MILLAR. Dated August 20. (*Complete.*)

10680. "Completing electric circuits." P. EVERITT. Dated August 20.

10696. "Working engine room telegraphs and other telegraphic communication on board ship and apparatus therefor." T. F. SMITH, C. SIMPSON, T. LOCKERBIE. Dated August 20.

10715. "Support for electrical conductors." H. FURSE, H. TOMLINSON. Dated August 21.

10720. "Electro-propulsive apparatus and the application thereof to wheeled vehicles or rolling stock." W. H. AKESTER. Dated August 21.

10724. "Telephonic transmitters." P. RABBIGE. Dated August 21.

10765. "Secondary generators for the conversion of electrical energy." W. LOWRIE. Dated August 23.

10810. "Incandescent electric lamps; working same." J. T. ARMSTRONG. Dated August 24.

10824. "Electrical batteries; working same." J. T. ARMSTRONG. Dated August 24. (*Complete.*)

10831. "Medium for producing electric light." H. de CLAIEMONT, C. L. FIELD. Dated August 24.

10851. "Electric alarm clocks." J. W. BROWN, F. T. BROWN. Dated August 25.

10868. "Obtaining zinc for coating metals galvanically." J. LEA, H. R. HAMMOND. Dated August 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

8491. "Improvements in signalling and switching apparatus for telephonic purposes, such improvements being applicable either wholly or in part for other electrical purposes." A. COLEMAN. Dated July 14. 8d. Claims:—1. The securing of a perfect rubbing contact between or with metallic surfaces when the flap of an electrical indicator is brought into action. 2. That these metallic surfaces are secure from mechanical damage and protected from dust.

8574. "An improved process and apparatus for treating metals, alloys, and especially auriferous ores by electrolysis." H. R. CASSEL. Dated July 15. 8d. The object of the invention is to treat metals, alloys, and ores, and especially auriferous compounds, by electrolysis in an apparatus in which nascent chlorine and oxygen are generated, by means of which the metals are dissolved, and are then deposited at the negative pole, and subsequently in specially provided tanks. The claims are 12 in number.

9527. "Improvements in motors for electric railways." T. J. HANDFORD. (Communicated from abroad by F. J. Sprague, of New York.) Dated August 10. 8d. Claims:—1. The motor of an electric railway car or carriage having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle, substantially as described. 2. The motor of an electric railway car or carriage supported partly or wholly by springs from the car body, carriage body, or truck, and having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle, substantially as described. 3. The motor of an electric railway car or carriage centred upon the driving axle at one end and having spring supports at the other end.

9530. "Improvements in telephonic transmitting instruments." S. P. THOMPSON. Dated August 11. 8d. Claims:—1. In telephonic transmitters tubular conductors in loose contact with each other or with their supports and forming part of an electric circuit and acted upon directly by the air waves substantially as described and illustrated by the examples shown in the drawings. 2. The several arrangements of tubes constituting microphonic telephone transmitters as described and illustrated by the drawings.

10031. "Improvements in telephonic communications." H. WESTMAN. Dated August 25. 8d. The inventor encloses the telephone instrument within a sound proof cabinet which he places detached from the walls of the building, and isolated from the floor by the interception of yielding objects, such as springs, India rubber, felt, and the like. Claim:—The making and using portable soundproof boxes or cabinets, constructed and arranged substantially in the manner and for the purposes as described.

10384. "An improved automatic electric fire alarm." A. DALZIEL. Dated September 2. 6d. Relates to an automatic fire alarm worked by the expansion of mercury in a glass tube. Claim:—The apparatus, substantially as described.

10817. "An improved switch for electric lighting." N. G. THOMPSON. Dated September 12. 8d. Claims:—1. The application of a spring to maintain a contact plug in either one of two positions, as described. 2. The method of supporting the above spring by means of a bent bar or casting having a slight spring in itself, as described, or by any other sort of support, to effect the above purpose.

10832. "A new or improved electric indicator applicable to gas cocks." W. P. THOMPSON. (Communicated from abroad by L. Lenaerts and H. L'Ollivier, both of Brussels.) Dated September 12. 8d. Claims:—1. The described arrangement which works when the meter is turned off if one or more gas taps remain open; and which consists in establishing an electric circuit, which on the one part traverses the cock of each burner as long as this cock is not completely closed, and which on the other part can only be closed from the meter when this is totally turned off. 2. The combination of a gas burner whose tap forms part of an electric circuit, which, closed as long as the burner is open, is interrupted as soon as the burner is closed; with a meter whose tap forms part of the same circuit, but which is so arranged that this circuit, open when the meter is open, is closed on turning off the meter. 3. In combination with a gas burner and a meter intercalated in the same electric circuit, which is only completely closed when on the one part the gas cock is open and on the other part when the meter is turned off; a bell which acts when the circuit is closed.

12600. "Improvements in telephonic apparatus." D. J. SMITH and D. SINCLAIR. Dated October 21. 8d. The object of the invention is to provide simple and effective means for enabling an operator in a telephone exchange to check the payment of the charge made for the use of telephonic communication in a public call box connected to such exchange and to check the time during which the telephone is used in the call box while also permitting of the free use of the call box telephones by subscribers to the exchange system. The claims are six in number.

1886.

1292. "Improvements in telephones." H. EDMUNDS. (Partly communicated from abroad by H. S. Thornberry, of America.) Dated January 28. 8d. Relates, as far as the transmitter is concerned, to that class of telephone transmitters using a granular substance as the current varying medium, such as that known as the Hunnings transmitter, and the improvements relate to the means by which the contact is maintained between the complimentary fixed electrode and the granular conducting material, and to the form and to the position of the complimentary electrode relative to the flexible electrode. The inventor provides the receiving instrument with a commutator or switch which can be adjusted so as to alter the resistance of the coil. The claims are 14 in number.

1899. "Improvements in the art of telegraphy." G. A. CARDWELL. Dated February 9. 1s. 8d. Consists generally of a novel application of the multiple system of transmission, and particularly of the "Gray" harmonic system. The claims are 16 in number.

3448. "A novel method of shot firing and blasting in mines by the agency of electricity." F. BRAIN. Dated March 11. 8d. Claims:—1. For the purposes of shot firing and blasting in mines and the like by the agency of electricity, the use of the system of insulated "mains" and branch cables or "leads" with accessory parts, substantially as set forth. 2. The non-sparking switches described, operated in the manner and for the purposes, all substantially as set forth.

4133. "Improvements in electric arc lamps." H. PIEPER. Dated March 24. 8d. The improvements consist in the combination with the holder of one of the carbons (the said holder being made of soft iron) of a movable bar of soft iron placed close to the holder, a stationary piece of like iron fixed at some distance from the said bar, and an electric coil, the said parts being so arranged that an electric current passed through the said coil will on one hand produce magnetic attraction and, in consequence thereof, friction between the bar and the holder, while on the other hand it creates attraction between the bar and the stationary piece of iron, whereby the bar is caused to move towards the latter and to impart, through the medium of the said friction, motion to the holder, either for the purpose of breaking contact of the carbons, or in view of producing feed-motion. Moreover the improvements consist in means for causing the bar, after having attracted the holder, to move together with the same in a helical line in one direction, and thereupon to release the holder and to move in opposite direction while the holder is retained by a friction-brake, a feeding motion of the carbon secured to the holder being thus obtained. The improvements also comprise particular means for breaking and re-establishing the circuit of the electro-magnet of the feeding-device. The claims are seven in number.

6035. "Improvements in receivers, apparatus, and circuits for telephonic communication." A. J. BOULT. (Communicated from abroad by W. Marshall, of New York.) Dated May 4. 8d. Claims:—1. The receiving telephone described consisting of a condenser perforated through its leaves with a shunting in the said receiver. 2. A receiving telephone consisting of a shunted condenser, which is normally charged by a constant current on line, and current varying devices located at the transmitting station in a primary or transmitting circuit and adapted to vary the statical condition of the normally charged receiver and thereby reproduce articulate speech and other sounds which actuate the transmitter. 3. A receiving condenser telephone located in a normally charged secondary circuit extending to a transmitting station in combination with a high resistance shunt around said condenser a local primary circuit to said secondary circuit located at the transmitting station and containing current varying devices substantially as described. 4. A condenser telephone located in a normally charged secondary circuit extending from the transmitting to the receiving station in combination with a shunt around said condenser and current varying devices located in an independent circuit at the transmitting station whereby any variation in the current in said independent circuit creates a change of statical condition in the receiver and causes it to reproduce the sounds which cause said current variation substantially as described.

6042. "Improvements in and apparatus for reproducing sound from phonographic records." J. Y. JOHNSON. (Communicated from abroad by the Volta Graphophone Company, of America.) Dated May 4. 8d. Relates to producing in air, or other suitable medium, vibrations corresponding in form to sound waves by means of a record which has been formed in or by a suitable solid body, the inequalities, variations, or irregularities of which represent the sound to be reproduced. The claims are 15 in number.

6044. "Improvements in magneto-telephonic apparatus." F. H. BROWN. Dated May 4. 8d. Claims:—1. The combination with a transmitting instrument having a permanent magnet, helices wound around the magnet, and a diaphragm arranged in proximity to the poles of the magnet, of a receiving instrument of similar construction, connected in circuit with the transmitting instrument, the number of convolutions of wire in the transmitting instrument being greater than in the receiving instrument, substantially as described. 2. A permanent magnet having parallel terminal arms of the same polarity, and the extended arm of opposite polarity, which extended arm increases the magnetic intensity in the parallel arms, substantially as described. 3. The permanent magnet having parallel terminal arms of the same polarity, and the extended arm of opposite polarity, in combination with the diaphragm secured to one of the parallel arms and free to vibrate over the other, and a helix on one or each of the parallel arms, substantially as described. 4. In the magneto-telephonic system a magneto transmitting telephone having a magnetic field of greater intensity than that of its companion magneto receiving telephone, the said field varying in intensity in approximately the same proportion as the resistance between the said instruments.

6047. "Improvements in and means and apparatus for the reproduction of speech and other sounds by means of records." J. Y. JOHNSON. (Communicated from abroad by the Volta Graphophone Company, of America.) Dated May 4. 8d. Relates to the reproduction through the action of magnetism of sounds by means of records in solid substances. The claims are 16 in number.

6599. "Improvements in construction, fixing, and fitting electrical insulators for telegraphs." J. E. GRIFFITHS. Dated May 17. 6d. Consists chiefly of an iron nut cemented into the body of the insulator, into which the bolt can screw; also of an inner shade or cup to increase the length of the insulating surface.

CORRESPONDENCE.

The Upward Battery.

In reply to Mr. Walker's questions:—1st, whether there may be an inappreciable amount of local action, which, I presume, is what he means when expressed in ordinary electrical language. There is certainly none to be detected in ordinary working tests. If there is any at all, if H is formed, and if formed, where it goes to, I don't *know*, as I have no delicate experiments to go on, and no time to make them now.

What good these questions can do Mr. Walker I fail to see. He has been told that there is no time to make delicate analyses; he has also been told that after experience with the cell and rough analysis, we have no reason to suppose that any HCl is found there (whether or not, it is not of the slightest practical importance, though in after years it will form an interesting subject for investigation). Knowing this, Mr. Walker really does no good either to himself or anyone else by suggesting all kinds of possible or impossible reactions, for which he does not offer the slightest experimental proof, but which, he thinks, might exist and cause the formation of HCl in the outer cell. If he does think so, why does he not experiment for himself, instead of asking busy men to do so for him? Supposing that traces of HCl are subsequently found to be formed there, it makes no difference to the point at issue, over which Mr. Walker has come to such utter grief, viz., that the action of the cell is due to such formation.

C. W. S. Crawley.

I have to thank Mr. Conry for his kind remarks last week. In early experimental days when leaks sometimes occurred, the ordinary test of a rag dipped in ammonia was found an infallible way of at once discovering its source, though now, of course, it is never required. I hardly understand Mr. Conry's last paragraph where he speaks of bitter hosiility from electricians. For my part I have never yet heard or seen a word of condemnation or hostility from any electrician.

A. Réné Upward.

West Kensington,
August 25th, 1886.

[We think that this discussion, which is beginning to trench too much upon personal grounds, might now well be closed. We shall be pleased to publish anything relating to the practical operations of the battery which, after the written experiences of Mr. Cunynghame, should form a welcome addition to the comfort of many a private householder.—EDS. ELEC. REV.]